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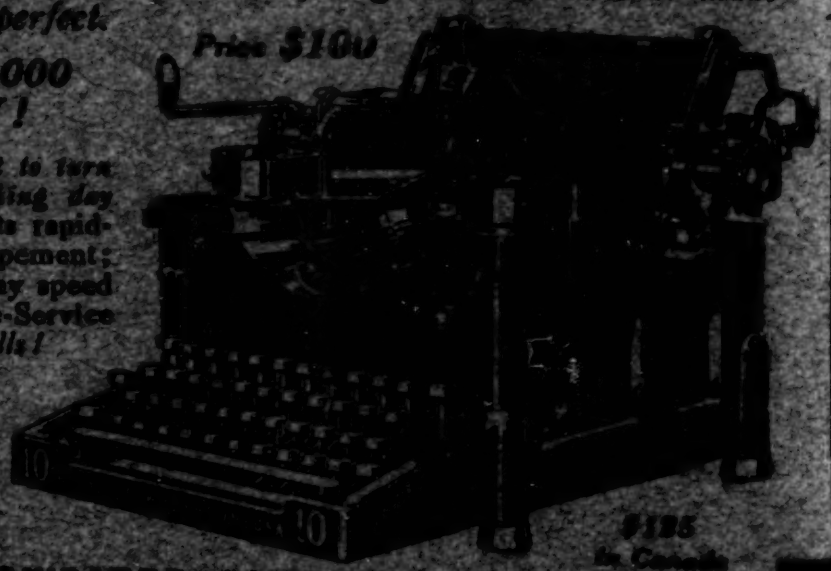

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VOLUME VIII FEBRUARY, 1917 NUMBER 2

THE JOURNAL OF EDUCATIONAL PSYCHOLOGY

A STUDY OF THE MEMORY OF YOUNG WOMEN

CEPHAS GUILLET

State Normal School, Westfield, Mass.

"In a child a good memory is well known by three properties, that is, if it be quick in receiving, sure in keeping, and ready in delivering forth again."—ROGER ASCHAM in *The Schoolmaster*, 1571.

In the State Normal School at Westfield, Mass., the present writer, who is in charge of the work done there in psychology, has conducted an investigation into the memory of two Junior classes. Eighty-two of the students in 1915, all of them young women admitted the previous fall from the High Schools, took all the experiments in three sections. Section A numbered 29 students, section BC 27 and section D 26. In 1916, 87 students of the new junior class took the same experiments, the sections now numbering 27, 32, and 28 respectively. The material was presented orally in series of ten units, was written by the class and then collected and examined by the investigator. Several days after the first presentation the series were presented again, and several days later the pupils were asked to recall them. In this third experiment in 1915 the pupils were given the first member of each series, except in the case of the continuous prose. In 1916 they were first to write it down from memory if they could, and it was counted only for those who so wrote it. The same was done in section D of the 1915 class. In 1916, 98 per cent. of the pupils recalled the first member in continuous prose, 95 per cent. the first related sentence, 90 per cent. the first related word, 79 per cent. the first unrelated word, 86 per cent. the first nonsense syllable, and 89 per cent. the first figure.

For 1915 the number of days that elasped between the first presentation and the second, and between the second presentation and the active reproduction of the different series, is shown by the following table, in which the numbers 1, 2, 3, 4, 5, 6 stand respectively for figures, nonsense syllables, unrelated words, related words, related sentences and continuous prose.

First Presentation of 1, 2, 3, 4	19 Jan.
Second Presentation of 1, 2, 3, 4	21 Jan.
Reproduction of 1, 2, 3, 4	26 Jan.
First Presentation of 5	21 Jan.
Second Presentation of 5	26 Jan.
Reproduction of 5	4 Feb.
First Presentation of 6	11 Feb.
Second Presentation of 6	16 Feb.
Reproduction of 6	18 Feb.

In 1916 the second presentation in all cases followed the first after an interval of four days, and the reproduction followed three days thereafter, all the material being used each day, namely, Jan. 3, 7 and 10.

The series of figures was 9417380562. The nonsense syllables were nar, toog, fap, gak, tum, neek, leb, qual, bast, pud. The unrelated words were air, when, up, sleep, past, canned, fray, cash, seat, mere. The related words were paint, green, grass, flowers, petals, yellow, faded, white, foam, fleece. Each of these series was presented in eight seconds and two minutes were allowed for the writing of them.

The related sentences were: 1. Time is money. 2. The love of money is the root of much evil. 3. Evil is the opposite of good. 4. The good alone are truly happy. 5. Happy are they who do what they know to be right. 6. Right action brings its own reward. 7. The wages of sin is death. 8. By sin came death into the world. 9. All the world loves a lover. 10. Love is the greatest thing in the world. These sentences took thirty seconds to read, and the pupils were allowed four minutes to write them.

The continuous prose was as follows: (1) Cicero ⅛ was born ⅛ at an obscure ⅛ country town ⅛. (2) His family ¼ was without wealth ¼, (3) yet ⅛ he rose ⅛ rapidly ¼, (4) until ⅛ at the age of 46 ⅛ he became ¼ consul. (5) In oratory ¼ he is placed ¼ side by side with Demosthenes ⅛. (6) He surpassed ⅛ the latter ⅛ in brilliancy ¼, (7) but ⅛ lacked ⅛ his moral ¼ earnestness. (8) His delivery ¼ was impassioned ¼, (9) his voice ¼ strong ⅛ and sweet ⅛, (10) his figure ¼ tall ⅛, graceful ⅛ and impressive ⅛.

Ten points were given for each series at each repetition of it, one point for each of the ten members. In the case of the figures a mark was given for a figure only when it was properly placed, that is to say, either in its proper rank or next after the figure that preceded it in the original series. In all the other series half was given for the correct unit and half for place. In the case of the nonsense syllables, if there was only one error, namely, the vowel or one of the consonants (initial or final) wrong, a quarter of a mark was allowed for the syllable and still a half for position. In the case of the continuous prose very few instances of disarrangement of order occurred. In marking the related sentences and continuous prose I had in mind correctness of thought rather than exact wording.

From the data I first made out a table of averages for the First Presentation (1 Pr.), Second Presentation (2 Pr.) and Reproduction or Delayed Recall (Rep.) of the six kinds of material, Figures 1 (Fig.), Nonsense Syllables (N. S.), Unrelated Words (U. W.), Related Words (R. W.), Related Sentences (R. S.), and Continuous Prose (C. P.), and for the two classes of material, Unrelated (U. M., the first three kinds) and Related (R. M., the last three kinds), also for the total number of marks obtained (M.). In some cases, besides the average, the maximum (Max.) and minimum (Min.) marks obtained are given. The greatest number of marks possible is also indicated.

TABLE OF AVERAGES

1915

	Possible 10																		Possible 30						Possible 60			Possible 30							Poss. 90		Poss. 180
	Figures			Nons. Syl.			Unr. Words			Rel. Words			Rel. Sent.			Cont. Prose			Unr. Mat.			Rel. Mat.			All Mat.			All Three Experiments								
	1 Pr.	2 Pr.	Rep.	1 Pr.	2 Pr.	Rep.	1 Pr.	2 Pr.	Rep.	1 Pr.	2 Pr.	Rep.	1 Pr.	2 Pr.	Rep.	1 Pr.	2 Pr.	Rep.	1 Pr.	2 Pr.	Rep.	1 Pr.	2 Pr.	Rep.	1 Pr.	2 Pr.	Rep.	Fig.	N. S.	U.W.	R.W.	R. S.	C. P.	U.M.	R.M.	M
A	6.1	7.9	4.1	3.8	5.2	3.3	5.7	6.7	3.5	7.7	8.2	7.3	4.4	5.7	3.9	5	7.2	6.6	15.6	19.7	10.7	17.1	21.2	17.9	32.6	40.9	28.7	18.1	12.3	15.9	23.2	14	18.8	45	55.9	100.9
BC	6.9	8.4	3.5	3.1	4.8	3.4	5.5	6.9	3.8	6.5	8.1	6.5	4	6.2	3.9	5.6	7.5	7.1	15.5	20.1	10.5	16.1	21.9	17.3	31.5	41.9	28.1	18.8	11.3	16.2	21.1	14.1	20.2	46.7	55.1	101.8
D	6.7	8.4	3.5	3.8	5.4	3.5	6.2	7.3	3.9	6.6	9	7.4	4.1	5.5	3.2	4.8	6.7	5.9	16.7	21.3	11	15.5	21.6	16.7	32.2	42.9	28	18.6	12.7	17.4	23	12.8	17.4	48.4	53.9	102.3
All	6.5	8.2	3.7	3.6	5.2	3.5	5.8	7	3.8	6.9	8.4	7.1	4.2	5.8	3.7	5.1	7.1	6.5	15.9	20.3	10.7	16.2	21.5	17.2	32.1	41.8	28.3	18.4	12.3	16.6	22.4	13.7	18.7	46.9	55.4	102.3
Max.	10	10	10	9	9	9.5	9.2	9.5	8	10	10	10	7	9.7	8.7	8.7	9.7	10	24.5			23.2			44.2	55	46.7							71.7	76.2	134.2
Min.	1	3	0	0	1.5	1	3	4.2	0	2.7	4	.5	1.7	2.5	1	2	3.2	3	9			11			22.5	24.2	13.2							21.2	37.2	61.7

1916

	Possible 10																		Possible 30						Possible 60			Possible 30							Poss. 90		Poss. 180
	Figures			Nons. Syl.			Unr. Words			Rel. Words			Rel. Sent.			Cont. Prose			Unr. Mat.			Rel. Mat.			All Mat.			All Three Experiments								
	1 Pr.	2 Pr.	Rep.	1 Pr.	2 Pr.	Rep.	1 Pr.	2 Pr.	Rep.	1 Pr.	2 Pr.	Rep.	1 Pr.	2 Pr.	Rep.	1 Pr.	2 Pr.	Rep.	1 Pr.	2 Pr.	Rep.	1 Pr.	2 Pr.	Rep.	1 Pr.	2 Pr.	Rep.	Fig.	N. S.	U.W.	R.W.	R. S.	C. P.	U.M.	R.M.	M
A	6.7	8.4	6.4	3.9	4.9	4.3	5.4	6.4	4.4	7.6	8.6	7.6	3.9	6.2	4.7	4.9	7.3	6.9	16	19.8	15.2	16.4	22	19.3	32.5	41.8	34.4	21.5	13.2	16.3	23.8	14.8	19.1	51	57.7	108.8
BC	6.5	7.2	5.2	3.2	4.5	2.3	5.4	6.4	2.7	7.2	7.8	6.2	3.6	5.3	4.5	4.6	7	6.4	15.1	18.1	10.3	15.3	20	16.9	30.4	38	27.2	19	10	14.5	21.2	13.3	17.8	43.4	52.3	95.7
D	6.1	7.3	5.8	2.8	4	2.7	5.5	6.6	4.6	7	8.7	7.8	3.7	5.3	5.1	5.1	7.5	7.2	14.4	18	13.2	15.7	21.4	20.2	30.3	39.4	33.3	19.3	9.6	16.7	23.5	14.1	19.8	45.6	57.4	103
All	6.4	7.6	5.8	3.3	4.5	3	5.4	6.5	3.9	7.3	8.3	7.1	3.7	5.5	4.8	4.9	7.2	6.8	15.2	18.6	12.7	15.8	21.1	18.7	31	39.8	31.4	19.9	10.9	15.8	22.7	14	18.9	46.5	55.7	102.14
Max.	10	10	10	7	8.5	8.2	8.5	10	10	10	10	10	7	9	10	7.4	10	10	24.5			22.9														
Min.	1	3	0	1	2	0	2.2	3	0	4.2	3.5	1	1	2.5	2	1.9	3.2	1.9	5.2			10.2														

Generalizations

1. When series of ten figures, nonsense syllables, unrelated words, related words, related sentences, and a piece of continuous prose containing ten statements, are spoken, one series at a time, to a class of normal students (young women), only a little over half of the whole material (53.5% in 1915, 51.7% in 1916) can be at once written down by them as given.

2. If this material be presented again, several (from two to five) days later, from a seventh to a sixth of the material additional can now be written, or nearly seven-tenths in all.

3. After a few days interval, nearly as much can be recalled (47% in 1915, 52.4% in 1916) actively without any further presentation of the material (except, where necessary, the first member, as indicated above), as could be written immediately after the first presentation, showing how effective a second presentation is, and suggesting the importance of repetition and review in preventing the disappearance of what has once been in the mind.

4. Every experience leaves behind a disposition or latent tendency to recur to consciousness. Dispositions gradually weaken, fade or relax if not aroused, but repetition and reproduction stamp them more strongly upon the mind. Such dispositions vary greatly in strength with different individuals, being even twice or three times as strong in some individuals as in others of the same class of students. For example, in 1915 one student, at the first presentation of the six kinds of material, reproduced 73.7%, another only 37.5%. Upon the matter being presented again, one reproduced 91.7%, another but 40.4%, while, after an interval of several days, one was able to recall 77.9%, another only 22.4%. Of one or more of the six classes of material some students at the first presentation reproduce from 70% to 100%, while others reproduce only from nothing at all to 30%. Some dispositions may be compared to the eager sprinter tensely awaiting the signal to start, while others stand limp and listless.

5. Two classes of normal students of different years scarcely differ as wholes in the kind of mentality tested by this experiment. The average total number of points out of 180 taken by each member of the class of 1915 was 102.3, and by the class of 1916,

102.14. Different sections, numbering nearly thirty students each, of the same class, or of different classes, differ very little in memory in the aggregate, great as are the individual differences. A group of thirty persons is therefore large enough to furnish reliable generalizations on the memory. There are comparatively few extremes in any group: most individuals are of approximately average ability.

6. The consciousness of the first member of a chain of dispositions tends to bring the other members into consciousness in the order of acquisition or experience. But there is more in our minds than we can bring to consciousness at will. Examinations are therefore inadequate tests of culture. What we "have forgotten" may be more influential and formative than the matter that readily comes to consciousness.

7. In most people related material is more easily acquired, better retained and much more readily recalled than unrelated. The closer and richer the logical relation, that is, the more meaning the material has, the easier is the work of grasping and reproducing material. Ten related sentences containing 69 words are almost as easily acquired, retained and reproduced as ten related words. This is doubtless because the former embody more complete and hence more interesting cognition than the latter; they find something in the mind to which to attach themselves; sentences are in fact complete statements of thought or judgment, while single words are but vague concepts. This generalization, besides other suggestive value, has a direct bearing upon the teaching of reading. The sentence-method is evidently psychologically sounder than even the word-method, not to speak of the old letter-method.

8. A series of ten figures are more easily acquired in their sequence than a like number of nonsense syllables or even words. This is doubtless due to the circumscribed range of choice in the case of figures, together with the familiarity of each of the figures as compared with the nonsense syllables. The mind also readily arranges rhythmically familiar sounds like figures, and rhythm aids the memory.

9. It would seem also that with figures the element of chance would enter in as a factor in their arrangement in an especial manner, since there are only ten figures and the material is thus already known. To test this, I had the students write down what they guessed to be the arrangement of ten figures that I

had written out. It came out that on an average one of the ten figures was placed correctly by each pupil, or to be exact, .99 of a figure. Moreover, the result for each section was nearly the same as that for the whole class, namely, an average of one figure each for section A, .87 for section BC, and 1.1 for section D.

The pupils expressed great surprise at this result, which struck them as almost uncanny, and they felt sure it could not occur again, but that next time no one would get any right, as many said, or there would be greater discrepency. So at their urgent request I made the experiment again with a new series unknown of course to them. I assured them it would come out much the same, and it so proved, for this time the results were, for the class .76 of a figure per pupil; for A .82, for BC .68, and for D .79. In both experiments the maximum number of figures rightly placed by any pupil was 4 and the minimum 0. While there was considerable discrepancy as to the number in the two experiments scoring 0 and 1, the same number obtained 2 in both instances, namely 15, and the number placing 3 and 4 right respectively, was 1 and 2 in the first experiment, and 2 and 1 in the second!

Such a result, even as the similar results with the memory, showing different groups and different years averaging about the same in various qualities and even in chance action, cannot but impress one with the similarity of human minds. And one is led to think of the facts of history and experience that bring the same testimony to the oneness of human behavior. I would remind the reader of the universally mythopeic character of human thought before the advent of Greek science and philosophy with the great original genius, Thales, and of the prevalence of practically the same myths and legends in widely separated portions of the globe. The same is true of fairy stories, animal tales and mother goose rhymes. The evolution of both oral and written speech affords the most striking and fascinating illustrations of this principle. In our own scientific and inventive age the law is seen to operate with quite as remarkable a precision. Witness the many instances of the same invention or the same scientific discovery (*e. g.*, a new planet), or generalization (*e. g.*, Natural Selection by Darwin and Wallace, Mendel's Law of Mutations by Mendel and De Vries), being made by different minds independently. And the spirit of the age—

what is that but the common element in human minds at the stage of evolution reached?

10. Nonsense syllables are much more easily reproduced after a long interval than figures. This is doubtless due to the monotony of the figures, and the curious and striking sounds of the nonsense syllables, which, besides making a deeper impression (*i. e.*, leaving behind a stronger disposition), also tend to set up associations as clues. The possible arrangements are equally great in both cases, consequently only the order counts. The general helplessness regarding the recollection of dates and other numerical facts is a corroborating illustration of this difficulty. Figures are words singularly devoid of concrete content. The weakness of the memory for words lacking in concrete meaning is a fact of especial significance for the teacher of little children, whose interest in the abstract is so slight.

Nonsense syllables are less easily acquired than words for immediate reproduction. This is explained by the greater familiarity of the words, and especially the difficulty of forming a visual image of the nonsense syllables. Though the immediate grasp of attention was much greater for unrelated words than for nonsense syllables, the attention for unrelated words was scarcely more effective for delayed recall, and the memory (as measured by a method to be explained later) was even poorer for unrelated words than for nonsense syllables. The unrelated ideas expressed by the words were evidently harder to remember than a succession of meaningless sounds. Perhaps this is because in the case of the words the attention is divided between the sound and the meaning (withal a very uninteresting meaning), while in the case of the nonsense syllables the attention is concentrated upon the sound. Neither of the two types of mind is much appealed to by a series of unrelated words, while the mind that I shall call, for want of a better adjective, image-forming, finds an interest in the new and striking sounds of the nonsense syllables. There is a tendency also to rhythmize a succession of meaningless sounds.

11. There is little difference between the capacity to acquire related and unrelated material for immediate reproduction, the weaker dispositions left behind by the unrelated material being yet strong enough for immediate reproduction. The impression does not need to be so deep, *i. e.*, the disposition does not need to be so strong or tense, as for delayed reproduction. That is why

the immediate and delayed reproduction of figures differ so markedly. This proves the futility, for culture, of cramming for examinations. The mass of dispositions thus hastily implanted being so weak, there is little chance for their apperception or organization with the logical system already in the mind, for which time and reflection are necessary. Thus little that is permanent is accomplished. Or, putting it in another way, matter can be learned mechanically well enough for examination purposes, which proves the unreliability of the results of set examinations. The proper way to test by examinations, therefore, is to give them when they are not expected, and upon material that has not been recently presented. Just after a vacation, for example, is better than just before.

12. Unrelated words are more easily reproduced after a long interval than figures, doubtless because of the meaning attached to the words as contrasted with the utter emptiness and monotony of the figures.

13. Seven is the maximum number of figures the average normal school student can grasp in one act of attention, and the longest series that she can grasp complete. This fact came out in an experiment with eighty students in 1914, who were given seven series of from four to ten digits orally.

14. One may have a poor "mechanical memory" and a relatively good "logical memory," and vice versa. For example, one student made 14.6 per cent. more points with the unrelated material than with the related, and another 35 per cent. more with the related than with the unrelated. Only 16 of the 82 students in 1915 made a better record with the unrelated than with the related material. Of these 16, six stood above the average in general standing and ten below. The only pupil of exceptional ability as measured by school standing who did worse with the related than the unrelated material has told me that she was unwell and nervous and over-anxious during the time of the experiments.

15. In endeavoring myself to reproduce long series of figures, I found that, if I attended to the matter with confidence and determination, I could succeed in recording figures correctly of which I had but the faintest shadow of an image, so faint that I was surprised when I found them correct. Several of the pupils said they had had the same experience. Energy of concentration and will is undoubtedly a factor in successful

mental work. It is, therefore, of importance to be in good physical condition when undergoing examinations.

Inductions from Correlations

I now proceeded to a closer analysis of the data with a view to determining more accurately the mental factors involved.

One sees that the result of the first presentation is a measure of the grasp of attention for immediate recall, or one may call it *prompt grasp of attention*, or *instant attention* for short. It has sometimes been called "*acquisition.*" Retentiveness proper was here hardly involved, the time being so short, neither was reproduction, the material having never left consciousness; so that the record thus immediately taken after the first presentation is as good a measure as can be obtained of the grasp of attention. By attention we must here understand not the energy, for the pupils cannot have differed greatly in the amount of effort put forth, but the *scope of the mental imagery* in the case of meaningless material and the greater power of ideation of logical grasp, of perception of meaning and relations, in a word of *understanding*, in the case of the more meaningful material.

Similarly the *quantum* actively recalled on the last day of the experiment may justly be viewed as a measure of the *effective grasp of attention*, only those experiences being recalled that had left behind stronger dispositions. This factor is generally referred to as *delayed recall* or *reproduction.*

But what are we to use as a measure of retentiveness?

May the measure of *retentiveness* not be found in the percentage that delayed recall is of the highest record immediately after the presentation, whether the first or the second? For example, if in nonsense syllables a pupil scored 3, 7 and 2 respectively for first presentation, second presentation and delayed recall, her instant attention for this material would be 30 per cent., her second act of attention 70 per cent., her effective attention or reproduction or delayed recall (resulting from two acts of attention) 20 per cent., and her retentiveness $28^4/_7$ per cent. The records from the first and second experiments showed what they had grasped. Manifestly what they reproduced later after a considerable interval must be compared with the better of these and not with the number of units presented (which was always ten); for they could not be expected to recall what had never been strongly enough in their memory to be set down

just after they had heard it. But they may be fairly judged as to retentiveness by the persistence for several days of the materials they have not only heard but written down and thus also seen and no doubt inwardly pronounced while writing them.

Taking the 1916 class, I found that in 18.6 per cent. of the cases for all six materials the percentage so obtained was above 100, and in a quarter of these cases even from 20 to 100 above 100. While there might have been some irregularity, I know that this could not have been an important factor. The results suggest that a certain amount of mental activity went on more or less subconsciously and unintentionally, making it possible in some cases to reproduce better after a long interval than after a short. The correlations show, however, that it made very little difference whether I regarded 100 per cent. as the maximum, reducing to that figure all above it, or made 120 the maximum. In figures, nonsense syllables, unrelated words, related words, related sentences, and continuous prose the number of cases above 100 per cent. was 9, 14, 11, 16, 18, and 26, respectively.

Correlations showing Relations between Different Mental Qualities

	1915	1916	Average
1. 1 Pr. N. S. & 2 Pr. N. S. =	+.47	+.58	+.53
2. 1 Pr. N. S. & Rep. N. S. =	+.53	+.34	+.44
3. 2 Pr. N. S. & Rep. N. S. =	+.28	+.34	+.31
*4. 1 Pr. N. S. & Ret. N. S. =	+.14 (max. 120)	+.48 +.44 (max. 100)	+.31
5. 2 Pr. N. S. & Ret. N. S. =	—.36 (max. 120)	—.22 —.18 (max. 100)	—.29
6. Rep. N. S. & Ret. N. S. =	+.73 (max. 120)	+.76 +.76 (max. 100)	+.75
7. 1 Pr. C. P. & 2 Pr. C. P. =	+.72	+.42	+.57
8. 1 Pr. C. P. & Rep. C. P. =	+.65	+.44	+.55
9. 2 Pr. C. P. & Rep. C. P. =	+.88	+.75	+.82
*10. 1 Pr. C. P. & Ret. C. P. =	+.21 (max. 120)	+.19 +.19 (max. 100)	+.20
11. 2 Pr. C. P. & Ret. C. P. =	+.21 (max. 120)	+.03 +.15 (max. 100)	+.12
12. Rep. C. P. & Ret. C. P. =	+.65 (max. 120)	+.61 +.68	+.63
13. Rep. C. P. & Ret. N. S. =	+.11	+.30	+.21
14. 1 Pr. N. S. & 1 Pr. C. P. =	+.11	+.03	+.07
15. 2 Pr. N. S. & 2 Pr. C. P. =	+.04	+.04	+.04
16. Rep. N. S. & Rep. C. P. =	+.23	+.23	+.23
17. Ret. N. S. & Ret. C. P. =	+.25 (max. 120)	+.17 +.26 (max. 100)	+.21

* For 1917, 1 Pr. N. S. and Ret. N. S. = +.24, and 1 Pr. C. P. and Ret. C. P. = +.09.

It is evident that the activity of subconscious cerebration was proportionate to the meaningfulness of the material.[1]

After working out numerous correlations with the assistance of my pupils with all the data (having constantly eleven classes in each curve of distribution), I found that the nonsense syllables were the most typical unrelated material and the continuous prose the most typical related material. Without, at present, therefore, dealing with the other sorts of material, I shall confine myself to these two typical classes.

Examining, then, the correlations between *1 Pr.* (instant attention, immediate recall or acquisition), *Rep.* (effective attention, delayed recall or reproduction) and *Ret.* (retentiveness) for nonsense syllables and continuous prose respectively, we find a strong direct correlation between the first two powers for both unrelated and related material, a very strong direct correlation between the second and the third, and a not very considerable but still direct correlation between the first and third powers (Correlations Nos. 2. 4. 6. 8. 10, 12).

What does this mean? In the first place the popular judgment "Easy come, easy go" is proved to be erroneous as a general statement.

In the second place, if we are to regard these powers as factors of the "memory," the memory is evidently a very unitary thing and each factor is to a very considerable extent a measure of the others. This being so, examinations, which are primarily a test of reproductive power (delayed recall), are at the same time a pretty fair index of the powers of acquisition and retention also, and thus useful for the purpose of ranking pupils objectively.

In the third place there must be a strong common element underlying the three factors or powers in question. A careful reading of the correlations should reveal this.

The fact that the first act of attention, that is to say, readiness of grasp or acquisition of unrelated material, has a considerable direct correlation with both delayed recall and retentiveness

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[1] I have just (January, 1917) conducted this experiment for the third time, and, so far as I have worked out the results, they confirm those stated in this article. For retentiveness, however, I have this time taken the percentage that reproduction is of the combined presentations, i. e., of the better of the records plus any *additional* material present in the other presentation-record. Naturally, the number whose retentiveness comes to more than 100 per cent. is now fewer. In R. W. there were two: 106 and 131; in R. S. four: 102, 104, 112, 114; in C. P. six: 102, 103, 105, 105, 115, 140. There were none for the other materials. This gives a juster idea of the matter. It should be added, however, that occasionally material that had not appeared in the records of the two presentations appeared in the delayed recall.

(Nos. 2 and 4), while the second act of attention has a slighter correlation with both, even, indeed, an inverse correlation with retentiveness (3 and 5), is another indication that the old adage "easy come, easy go" must be given up as far as unrelated material is concerned. In the case of related material, however, while the correlations of the two acts of attention with retentiveness were about equal (10 and 11), slow acquisition proved to be more effective than quick for delayed recall (8 and 9), time being more effective for the formation of clear ideas than of images, the latter depending more upon a peculiar native capacity than upon energy of effort.

There is further proof of this proposition. Attention (both first and second act) and delayed recall are more strongly correlated in the case of related material than in the case of unrelated (2, 3, 8, 9), while retentiveness and delayed recall are more strongly correlated in the case of unrelated material than in the case of related (6 and 12). Indeed, there is a very much stronger direct correlation between delayed recall and retentiveness for unrelated material than between instant attention and retentiveness, and there is even, as we have seen, an inverse correlation between the second act of attention and retentiveness, showing that the efficiency of the attention is not due to the effort of attention but to the retentiveness of the mind (4, 5 and 6). Where a second act of attention is necessary to the acquisition of unrelated material, retentiveness for such material is weak. A person who can retain unrelated material, therefore, is little dependent upon the amount of attention.

The capacity to recall related material evidently depends more upon that energy or repetition or application that results in clearness of the original impression, while that of reproducing unrelated material depends more upon native retentiveness for imagery experienced. It would seem, therefore, that no great retentive power is necessary for efficiency in the realm of thought, while the reverse is the case with the realm of mechanical association and meaningless sense-imagery.

One pupil will do as well after one act of attention to unrelated material as another will do after two acts of attention, or even better, owing to the superior retentiveness of the former (Corr. 2 and 3). This pupil has no more vivid sensations than another, but in her the images stick in the mind, while in the other they rapidly fade out unless repeated again and again. Mechanical

or sensory retentiveness, therefore, accounts for the power of instant attention to unrelated material as well as for the power of effective attention. Here, then, is the common element we sought, at least as far as unrelated material is concerned, namely *the native mechanical retentive power of the mind.* This is the prime factor of the memory. This *is the memory.* The other powers that aid us to remember are not memory at all. We shall see that they are mainly attention, mental imagery and understanding.

For the mastery of mechanical (*i. e.*, unrelated and comparatively meaningless) material, of which nonsense syllables are a type, retentiveness, which is a native gift, is more important than the effort of attention or concentration. To make up in part, however, for the lack of good retentive power one must apply oneself with repeated acts of attention. This shows the need of constant repetition and drill in school-work of a mechanical nature—if, indeed, work of such a nature should ever be required, and doubt is cast on this by the investigations of Kirkpatrick and Springer—and shows the injustice of accusing a child of inattention or indifference when he does not do well in such work. His failure may be due to his lack of native retentive power. Once pupils have really grasped an *idea,* however, we need not worry about their remembering it, whether they have good "memories" or not, for *the correlation between reproduction (delayed recall) and the second act of attention is exceedingly large (No. 9) while that between retentiveness and the second act of attention is exceedingly small (No. 11).* For *meaningful* material the *understanding* or the power of perceiving logical relations is essential, and when this quality is weak, it must be aided by repeated attention to the relations, that is, to the meaning (stimulated by the art of the teacher), just as weak retentiveness in the case of *unrelated* material must be aided by repeated attention to the imagery. Retentiveness and the power of grasping logical relations do not necessarily exist together in the same measure; but weakness in retentiveness may be more than compensated by ready ability to perceive relations, or even by diligent application where one's power of grasping logical relations is slow.

Thus we have found that *for efficiency in the mastery of unrelated and related materials respectively, one requires two quite different mental qualities, namely, retentiveness and understanding.*

Now by considering correlations 14 and 15 one will discover that *these two mental qualities are quite distinct and have nothing in common*, for there is practically *no correlation between the attention for the two kinds of material, related and unrelated*, whether the first or the second act of attention be taken. Excellence in one function does not imply excellence in the other, nor does it imply deficiency in the other.

Having established the independent existence of these two mental qualities, mechanical retentiveness and logical apprehension, it occurred to me that it would be interesting to correlate them with the pupils' general standing. The Junior subjects in the first year of the experiment (1915) were the ten following: English, Geography, History of Education, Psychology, Arithmetic, Natural Science, Drawing, Music, Gymnastics and Methods. The subjects taken by the Juniors of the second year of the experiment (1916) were English, Geography, Psychology, Arithmetic, Biological Science, Music, Gymnastics and Methods, or eight in all. I have made correlations with each of the subjects, but the material is so extensive that I shall reserve most of it for a future article, giving only the correlations with the subjects of each year taken together, called "General Standing," and with my own subjects of History of Education and Psychology in 1915 and Psychology only in 1916. I might mention here that for the two first terms of the year 1915 the correlation between my two subjects combined and general standing was +.675, and for the third term .51, and between psychology and general standing in 1916 for the first terms combined +.61, and for the third term +.71.

By consulting the correlations the reader may verify the following conclusions. *There is no relation between power of sense-imaging and general standing*, that is to say, general ability as tested by school teachers; for there is practically no correlation between attention to unrelated material (whether the first or the second act of attention) and general standing in the normal school subjects. (18, 19, 20.)

There is, on the contrary, a relation between ability to perceive logical relations and general ability, for there is a considerable correlation between both the first and the second act of attention to related material and general standing in the normal school subjects. (22, 23, 24.) As the correlation is somewhat stronger in the case of the second act of attention, it would seem that it

Correlations between Mental Qualities and School Standing

	1915			1916				
	1st & 2d Terms Combined	3d Term	Av. for Year	1st Term	2d Term	1st & 2d Terms Combined	3d Term	Av. for Year
18. 1 Pr. N. S. & General Standing	+.01	—.03	—.01	+.03	+.07	+.04		+.03
19. 2 Pr. N. S. & General Standing	+.01	—.09	—.04			+.07		+.04
20. Rep. N. S. & General Standing	—.09	—.03	—.06			+.11	+.10	+.11
21. Ret. N. S. (max. 120) & Gen. St.	—.09	+.02	—.04			+.09	+.16	+.13
22. 1 Pr. C. P. & General Standing	+.26	+.28	+.27			+.22	+.27	+.25
23. 2 Pr. C. P. & General Standing	+.29	+.36	+.33	+.32	+.28	+.34	+.38	+.33
24. Rep. C. P. & General Standing	+.24	+.27	+.26			+.41	+.41	+.41
25. Ret. C. P. & General Standing		+.03	+.02			+.24	+.18	+.21
26. 1 Pr. N. S. & Hist. Ed. & Psychol.		+.15						
27. 1 Pr. N. S. & Psychology		+.15		+.09	+.05	+.09	+.08	+.07
27b. 2 Pr. N. S. & Psychology							—.09	
27c. Rep. N. S. & Psychology.							+.04	
27d. Ret. N. S. & Psychology							+.18	
28. 1 Pr. C. P. & Hist. Ed. & Psych.		+.31						
29. 2 Pr. C. P. & Hist. Ed. & Psych.		+.32						
30. Rep. C. P. & Hist. Ed. & Psych.		+.26						
31a. 1 Pr. C. P. & Psychology							+.30	
31b. 2 Pr. C. P. & Psychology		+.23		+.23	+.34	+.34	+.39	+.32
31c. Rep. C. P. & Psychology.							+.47	
31d. Ret. C. P. & Psychology.							+.23	
32. N. S. (all 3 expsr.) & Gen. St.	—.03	—.06	—.05					
33. N. S. (all 3 expsr.) & my 2 subjs.	+.03	+.02	+.03					
34. C. P. (all 3 exps.) & & Gen. St.	+.35	+.39	+.37					
35. C. P. (all 3 exps.) & my 2 subs.	+.30	+.32	+.31					
36. Mach. Mem. & General Stand.	—.02	—.04	—.03					
37. Mech. Mem. & my 2 subjs.	—.07	—.10	—.09					
38. Log. Mem. & Gen. Stand.	+.28	+.30	+.29					
39. Log. Mem. & my 2 subjs.	+.25	+.27	+.26					

is at least no great disadvantage to be a little slow in grasping such relations, so long as one is "slow but sure." In this important matter, happily, diligence quite makes up for slowness. (22, 23.)

Mere retentiveness would seem to be very slightly and doubtfully related to general ability. (See Nos. 21 and 25 especially.) The presence of good retentive ability does not ensure good standing, neither does its absence condemn one to poor standing. Nor can one say that its presence is a hindrance, or its absence a guarantee of higher ability. *It is simply of no significance or importance.* This is indicated not only by the correlations of nonsense syllables and continuous prose with general standing respectively, but also by those of all the different classes of unrelated material (N. S., Fig. and Unr. W.) in all the experiments combined together in a single curve under the head of "mechanical memory" and all the results from the logically related materials combined under the name "logical memory" in the same way and each curve correlated with that for general standing (Correlations 36 and 38). The same is true when all three experiments in nonsense syllables are combined and correlated with general standing, and so also with the full data for continuous prose. (32 and 34.) By examining the correlations with my subjects substantially the same results will appear. The whole table of correlations, indeed, like the statistical table given earlier, is a beautiful harmonious picture of the reign of law in mental phenomena. The similarities between the two classes of normal school students stand out in an especially striking manner. It is evidently not our retentive power that conditions our general ability, nor is it our power of sense-imaging, neither is it primarily the effort of attention that makes us efficient; but *the ability to grasp logical relations and to see meaning is a considerable factor therein.*

"Do you mean to say," I shall be asked, "that the retention of logical associations is mechanical like that of sensory associations?" That, I reply, is what a study of the correlations suggests. Note in particular correlations 21 and 25, which show almost the same correlation between retentiveness for *related* material and general standing as between retentiveness for *unrelated* material and general standing, the correlations being very slight on the whole for both kinds of material.

It may be objected that, if the retention of sensory and that of logical associations are both mechanical, the correlation be-

tween them should be perfect, namely, +1, and that all I have established is that there is a mechanical element in the retention of both, which, it may be added, is further borne out by correlations 12 and 13, which show a much larger correlation between the delayed recall of related material and the retention of *related* material than between the delayed recall of related material and the retention of *unrelated* material. But the answer to this is that, while the retentivenesses for unrelated and related material appear to be both mechanical, they are really two kinds of mechanical retentiveness, involving different brain areas, and consequently cannot be expected to show a perfect correlation.[2]

It may be urged that the existence of a logical element in the retention of related material is suggested by the correlation, positive though slight, that appears between the general standing of the class of 1916 and their retentiveness for related material (+.24 and +.18), even though no such relation appeared in 1915. But it should be observed that there was a direct correlation of .09 and .16 also between retentiveness for *unrelated* material and general standing in 1916, or only .15 and .02 less than for related material. This slight difference (which appears also in the correlations, with psychology) may only show that the retentiveness for logical associations, mechanical though it be, is of somewhat more importance for general standing than retentiveness for sensory associations, just as the retention of logical associations is more strongly correlated with the delayed recall of related material than is the retentiveness for sensory associations (12 and 13).[3]

The mere retention, then, of logical associations would appear to be a mechanical thing—*i. e.*, a retention of the words independent of the ideas they express. When the ideas are also present,

[2] Indeed, for 1917, by the better method described in my previous footnote, I have found a very slight correlation between Ret. N. S. and Ret. C. P. (+.07). Moreover, the correlation between the various classes of material is always small. For 1 Pr. in 1917 N. S. & C. P. = +.25; N. S. & Fig. = +.11; U. W. & R. W. = +.31; R. S. & C. P. = +.22. Evidently both the grasp of attention and the retentiveness for different classes of material vary greatly, which bears out the contention of those who say there is no memory but only memories. These correlations are all positive, however, so that there is evidently a common element or basis of general retentive capacity.

[3] For 1917, however, I have just ascertained the correlation between Ret. C. P. and Psychology First Term to be —.05, and between Ret. N. S. and Psychology +.14. These slight variations from zero, therefore, have no significance. There is evidently no correlation between retentiveness of any kind and school standing. 1 Pr. with Psychology, on the contrary, for the first and second terms of 1916–17, gives +.38 and +.28 respectively, or substantially the same as in the previous year (+.30).

they are there not because of any excellence in the memory but by virtue of the clear original grasp of them as shown by the delayed recall or reproduction, which has constantly a substantial correlation with general standing and with psychology.

Why, then, I may be asked, does one often need to "brush up" for examinations? This is because, while the logical content has become an integral part of one's mental complex, the mechanical part, on the contrary, or the mere words in which the meaning is clothed, seeing that they depend not on understanding but on retentiveness, may fade away and thus make the meaning difficult to recall. Hence the necessity of brushing up for examinations, preferably by thinking over the subject and getting one's ideas upon it into some form, which is always a form of words. And the greater one's powers of linguistic expression, the more this brushing up can take the form of reflection, and the less one needs to reexperience the original (lecture, author, notes, etc.). This is a point of the utmost significance to the examiner, who ought to so frame his questions that they will test the student's understanding rather than his memory, if it is really the student's understanding of the subject that he desires to ascertain.

The correlations of 1915 seem to indicate that the ability to understand or apprehend related material at its second presentation is more valuable than the ability to reproduce such material later (Nos. 23 and 24), that what one understands has already entered into one's mental system, even though one may not be able to call it up out of this complex at will,—perhaps all the more on that account. But the correlations of 1916 do not bear out this conclusion. Further experiments are necessary. It *is* consistently suggested, however, that the ability to give forth related material immediately after its second presentation is a better index of mentality than the ability to give it forth immediately after the first presentation (Nos. 22 and 23). In the latter process the memory is likely to play a larger part than in the former. One who is dependent upon the perception of meaning and relations—the selecting and relating power of the mind—may require more opportunity for attending to these relations in order to reproduce the material than one who is more gifted with retentiveness. Other factors, of course, coöperate to make general ability. It must be remembered, also, that the fallible and changeable judgment of the teachers is a

factor in the standing assigned to a pupil. Of that I shall have more to say in a future article.

In conclusion I should like to say a word about the value of work of this nature to the normal students engaged in it. I have noticed a remarkable increase in accuracy in the working out of averages and correlations by the students. To see a whole class of young women, who have passed through not only the grades but the high school, differ among themselves and every one wrong in a matter that calls only for accuracy in copying figures and handling them according to the fundamental rules of arithmetic, makes one confess that there must be something in the criticisms of our schools that one sometimes hears from business men. At the same time the progress in accuracy that these same young women made in mathematically searching out the interesting truth hidden in the simple data of this experiment suggests the remedy.

The framing of generalizations based upon the results thus mathematically obtained from the experiment is a very valuable exercise; and such generalizations form a solid foundation for the intelligent discussion of other scientific articles and finally of actual schoolroom practice. One cannot dip into the human mind, however humbly and inadequately, without a fresh realization of its complexity and of the many factors that subtly enter into its composition. And no student can go through such an experience without feeling an increased respect for science, and in particular for that science upon which all thoughtful teaching must be based, if teaching is to become to these young students a profession and not—as some would have it—a mere mechanically acquired trade.

The results of the investigation plainly suggest the uselessness of efforts to "train the memory," that pedagogical fetich of the past. Even if one can improve it, it is not worth while doing so. The teacher should give all his attention to training the child's understanding and judgment, and his powers of linguistic expression. Once a child has been got to express an idea clearly in his own words, he is guaranteed against forgetting it. It is ever after a part of his mental equipment. What the teacher should constantly aim at, therefore, is to present culture material of such a nature and in such a way that it may enter into vital, meaningful relation with the child's present mental complex.

Nothing should be taught in isolation, but everything in situation, in application, in logical connection as part of a whole. Only thus can it be really assimilated.

No thoughtful person can enter any of our grade schools without being struck by the futility of much of the work done. Many of the facts and details presented and drilled upon are destitute of all fruitful meaning to the pupils, who later, with maturer intelligence and interest, could acquire, in a short period of study, much more than they are thus forced prematurely to learn during years of effort altogether out of proportion to the value of the matter presented. In fact, once the child has learned to read, his geography, history and literature should be mainly a course in reading, supplemented by occasional discussion within the scope of his interests and capacities, in which the teacher should try to lead him onward while never getting away from him.

PRACTICE AND TRANSFERENCE IN NORMAL AND FEEBLE-MINDED CHILDREN[1]

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PART I. PRACTICE

The work here reported was carried on to determine how feeble-minded children compare with normal children of the same mental age as regards practice effects and the transference of training. The problem is a large one, as no conclusions are valid unless they are true for the vast feeble-minded population as a whole. It is not to be expected that one investigation, conducted with small groups of children and with one particular set of tests, will lead to a final solution. It is reasonable to suppose, however, in view of the importance of the problem for the understanding of education and of the nature of intelligence, that the present work will be extended by others who will test and modify the conclusions here reached.

The plan of work adopted required four groups of children. These groups were a normal practice and a normal control group, and a feeble-minded practice and a feeble-minded control group. The children of each group were selected so as to give about the same average mental age, namely, nine years.

The mental age of the feeble-minded children, inmates of the State School for Feeble-Minded at Faribault, Minnesota, was determined by means of Kuhlmann's revision[2] of the Binet tests. Children who had not been tested recently were retested. All were tested by Dr. Kuhlmann himself, and the ages used are the ones furnished by him. The average chronological age of both the feeble-minded groups was slightly under fourteen.

In the case of the normal children, the chronological age alone has been used. It is reasonable to suppose that with these children the difference between the average mental age of a group and the average chronological age would be slight. It would very likely be less than the difference between the average mental age as determined by the Binet tests and the average true mental age.

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[1] The writer begs to acknowledge gratitude to Dr. A. C. Rogers, Superintendent, and to Dr. F. Kuhlmann, Director of Psychological Research of the Minnesota School for Feeble-Minded and Colony for Epileptics. Thanks are also due to Dr. F. E. Spaulding, Superintendent of the Minneapolis Public Schools.

[2] J. of Psycho-Asthenics, Monog. Sup., Vol. I, **1**, pp. 41.

The composition of the various groups with respect to age is shown in Table I. The ages have been left in years and months. Thus, 9.3 means nine years and three months. Boys are distinguished by a star placed before their ages.

TABLE I

Composition of Groups with Respect to Chronological and Mental Age

Group	F. M. Practice		F. M. Control		Normal Practice		Normal Control	
No.	Chron.	Mental	Chron.	Mental	Chron.	Grade	Chron.	Grade
1	15.0	9.3	*15.2	9.4	*9.8	3A	8.10	3B
2	*12.6	9.4	*10.5	9.4	*9.6	3A	*9.0	3A
3	15.3	9.8	*13.8	9.2	8.7	3B	*8.11	3B
4	19.3	10.0	20.7	8.8	8.1	3A	9.2	3A
5	12.5	9.0	12.4	8.2	8.2	3B	*9.1	3A
6	17.0	9.2	*12.1	9.0	8.8	3A	9.2	3A
7	12.8	8.4	18.11	8.6	9.11	3A	8.6	3A
8	*12.0	8.0	14.1	9.0	*9.3	3A	*9.1	3A
9	*13.1	8.2	10.3	8.2	9.2	3A	*9.1	3A
10	15.0	8.10	15.2	9.6	9.5	3A	8.11	3A
11	13.1	8.2	20.4	8.8	*9.3	3A	9.0	3A
12	16.6	9.0	*12.8	8.2	9.2	3A		
13	*11.6	8.0	*10.11	8.0	9.7	3B		
14	*11.6	9.6	*11.3	9.0	*9.0	3B		
15	*12.2	8.0	*11.3	8.2	*8.11	3A		
16	12.9	10.4	11.6	9.0	9.2	3B		
17	10.1	7.11	15.6	8.4				
18	13.3	9.2						
19	14.8	8.0						
20	*14.5	8.6						
Av.	13.8	8.10	13.10	8.9	9.1		9.0	
M. V.	*1.9*	*.8*	*2.8*	*.5*	*.5*		*.2*	

The groups were selected so as to secure equality, not only in mental age, but also in initial ability. The feeble-minded children were selected by going through the files of the state institution and writing down the name of every inmate, under twenty chronologically, recorded as mentally eight or eight and a fraction. A few somewhat under eight were also listed, when there was reason to believe that they had improved since their last testing, which in some cases was several years back. This procedure gave a list of over one hundred children. This list was taken to one of the officers of the institution who scratched off the names of the children who for one reason or another were not available. Some had epilepsy, some were working on the farm, some had gone home, some were sick, some lived in a cottage too far away for the attendant to go after them, etc. The list of available children was thus reduced to fifty.

Work was begun with all these children, in two sections, work with one of the sections beginning a week later than with the other. At the end of the initial tests, both sections were divided into two groups of equal average initial ability, one group becoming thereupon the practice group and the other, the control group. For the final tests the groups came together again in two sections as at first. While the work at the state institution was being carried on, children were constantly leaving for home, for vacation, so that, while at the beginning of the work there was a practice group of 28 and a control group of 22, at the end, the practice group numbered only 23 and the control group 19.

In order to equalize the feeble-minded groups with each other in initial ability in the end tests and with the normal groups in initial ability in both the practice tests and end tests, it was necessary to reject the results of several children. The number rejected was the smallest that would render all four groups about equal in initial ability. Three were rejected from the feeble-minded practice group and two from the feeble-minded control group, thus leaving 20 in the former and 17 in the latter. The records that were rejected were above the average and were made in all cases but one by children whose mental age, at the last testing, was ten or over. The rejecting of these cases rendered the average age of the feeble-minded groups a few months less than that of the normal groups, but it was thought better to have equal initial ability than exact equality of mental ages.

The normal groups were selected, each from a different Minneapolis school, by going to the principal and asking for a group of children who were of normal grade for their age and who would average nine years chronologically. The normal practice group originally numbered nineteen, but as two children missed several periods on account of sickness, and one girl was dismissed after a few days because of chorea, the group became reduced to sixteen. In the case of the normal control group, in the Lowell school, the ranks were greatly depleted at the time of the final tests on account of a scarlet fever epidemic which broke out in the school. The original group of nineteen was reduced to thirteen. Two of these thirteen were rejected in order to get a group which matched the other three groups in initial ability.

The plan of work followed was the same for both the normal and feeble-minded groups. First, both the practice and control

groups were given the end tests, four in number. The four end tests were all given the same day, but given twice, so that two days were devoted to them at the beginning and also at the end of the work. They consisted of the following: sorting five lengths of sticks into five boxes of corresponding length; sorting colored pegs; a letter cancellation test; and a geometrical form cancellation test. After the initial giving of the end tests, the practice group was given thirteen days' practice (consecutive except for Saturdays and Sundays) in the practice test. The control group "rested" for the same period. At the end of these thirteen days, in the case of both groups, the end tests were given again.

Before taking up the results on transference, those on practice will be presented. After a detailed description of the practice test and the method of giving it, the data will be presented in full as tables and practice curves and then discussed with some reference to related work of previous investigators.

The practice work given to the practice groups was a geometrical form sorting test, consisting in sorting gun wads on which were pasted labels bearing the printed outlines of simple geometrical forms. There were five different kinds of these labels, and wads bearing the same kind of label had to be sorted into the same box. The outlines used were those of the Woodworth-Wells substitution test[3] namely, star, circle, square, cross and triangle. Woodworth-Wells blanks, after being painted on the back with mucilage, were cut up until 10,000 small bits of paper were secured, each having printed on it a geometrical form. These printed forms were stuck onto gun wads, the same form being stuck on both sides of the wad. These gun wads were then divided into twenty sets of 250, each set containing 50 of each type. The set of 250 was placed in a paste-board box 6″ square and 1.5″ deep. Each wad had to be transferred from this box into a small box, bearing the same label. The small boxes, five in number, were 3″ x 2″ x 1.5″. They were placed in a line at the edge of the child's desk furthest from his body, and the large box placed between the body and the line of small boxes. The order in which the small boxes was placed was changed every second day, as it was thought best to exclude practice effects due to becoming familiar with a certain order and to prevent the test from becoming too automatic.

[3] Psychological Monog., Vol. XIII, **5**, p. 53.

Preliminary practice trials with a few children showed that it would not require much more than 4 minutes to sort the entire 250 wads. As 4 minutes did not seem long enough for a day's practice, it was decided to give the test twice, allowing 4 minutes each time. On account of the labor of preparing the tests and the number of boxes required, only one set of tests was used. Consequently, immediately after the first sorting, the children were instructed to dump the wads again into the large box. The box was then covered, the wads shaken up and the sorting done over again. Only the results of the second sorting were counted, except on the first day. On this day, only one sorting was required, so that it would be possible to obtain the really initial ability of each child.

The instructions were to sort the wads as rapidly as possible, using only one hand and picking up only one wad at a time. No mention was made of accuracy. Each day the children were reminded that they should do their "level best" and that it was how many they got sorted that counted. With these instructions, which were solely and unambiguously for speed, the best way of scoring is to take merely the total number correctly sorted; and it is this number that is given in the tables and practice curves. The number of mistakes made was recorded, but was found so small that space will not be taken to present the data on this point for the separate individuals, but only for the groups. The number sorted was noted separately for each form. It was found that the total number sorted by each child at each testing was usually well distributed among the five different forms. Consequently, only the total number sorted will be reported.

Every effort was made to keep the conditions as uniform as possible throughout all the work with all the groups. That perfect uniformity was attained is, naturally, improbable. In both groups certain boys at times became more interested in each other than in the tests. This was particularly true of three boys in the normal group, and remained true even after their seats were changed. On the other hand, it is true, that, in a general way, the feeble-minded children were more disorderly than the normal ones. The disorderliness of the feeble-minded children, however, was kept in check. They came in and went out boisterously, and one hardly dared turn his back on them;

but, while the actual work was in progress, they seemed always to be trying to do their best. All the tests on both groups were given by the writer, who tried to maintain throughout a machine-like regularity in his directions. It is probably impossible, however, entirely to avoid variations in enthusiasm, which may affect the class. Other varying factors were the weather (the feeble-minded were tested in the summer vacation and the normals in the fall) and the work done by the children during the forenoon (both practice groups were tested in the afternoon).

The results are given in Tables II and III. In Table II, are given the scores made by each child on each day, and also the averages for the group. Immediately below each average, in the line headed, at the left, P. E., is given the probable error of a single measurement. In the line headed, at the left, Av. Er., is given the average number of wads wrongly sorted. It will be seen that this is usually much less than one per child, and therefore of neglible importance. The averages of Table II are plotted as practice curves in Figure 1. In Table III, are given for each child the initial ability, the final ability, the absolute improvement (I) and the percentage improvement (% I).

TABLE II

Data on Practice in Sorting Geometrical Forms, by Normal and Feeble-Minded Children of the Same Mental Age

*Order	1, 2, 3, 4, 5		5, 1, 2, 3, 4		5, 3, 2, 4, 1		4, 1, 3, 2, 5		1, 5, 2, 3, 4		4, 1, 5, 3, 2		3,1,2,4,5
Trial	1	2	3	4	5	6	7	8	9	10	11	12	13
F. M. 1	129	128	126	158	139	163	169	158	185	167	158	171	175
" 2	94	116	101	139	129	144	130	135	114	121	150	131	146
" 3	154	188	174	190	213	197	230	218	218	204	222	226	201
" 4	112	166	177	190	166	197	176	185	200	186	192	178	203
" 5	120	145	157	165	180	186	186	194	208	222	197	224	193
" 6	108	148	144	167	156	152	152	175	181	192	173	179	167
" 7	127	140	129	120	126	128	143	143	146	143	141	143	144
" 8	94	125	115	134	162	173	174	213	169	206	199	191	209
" 9	136	132	128	139	146	160	139	169	120	128	132	157	166
" 10	120	142	116	119	138	155	146	137	164	159	150	152	142
" 11	138	169	169	173	177	172	168	161	167	169	186	155	184
" 12	125	158	147	142	146	141	133	170	200	157	188	167	182
" 13	83	79	77	112	90	101	87	107	101	107	102	104	111
" 14	127	144	141	165	127	140	145	108	133	186	168	176	212
" 15	122	94	103	98	122	105	91	97	102	93	81	102	103
" 16	104	123	99	99	121	125	121	136	137	127	140	158	149
" 17	124	166	139	139	146	181	171	184	192	193	188	200	179
" 18	140	175	181	179	190	192	193	199	199	192	196	209	214
" 19	142	154	164	182	181	223	188	188	218	202	197	217	208
" 20	114	143	149	161	152	163	157	187	188	203	185	188	203
" Av.	121	142	137	149	152	160	155	163	167	168	167	171	175
" P. E.	*12*	*17*	*19*	*19*	*19*	*20*	*23*	*23*	*25*	*26*	*23*	*23*	*22*
" Av. Er.	1	1	0	1	2	0	1	1	0	1	1	1	0
Normal	147	148	151	152	191	166	182	176	191	173	182	187	197
" 2	144	156	156	150	176	172	152	166	157	144	143	165	176
" 3	130	149	140	144	164	198	195	200	199	180	177	192	191
" 4	119	135	127	160	157	177	156	151	182	173	165	149	166
" 5	114	137	142	150	148	168	162	148	149	161	156	163	197
" 6	118	136	127	154	158	170	153	170	151	166	147	173	159
" 7	107	125	131	139	149	143	149	140	148	153	163	169	173
" 8	125	143	146	128	149	184	154	166	162	197	178	173	163
" 9	100	112	95	107	119	116	131	120	115	133	125	129	132
" 10	122	150	158	166	160	175	172	198	198	182	191	224	213
" 11	113	153	141	143	141	160	165	172	155	150	172	172	186
" 12	104	117	87	132	126	146	147	169	152	151	157	157	163
" 13	99	76	119	106	119	124	124	107	112	135	135	142	144
" 14	121	131	99	119	137	130	109	153	150	141	156	152	156
" 15	155	145	154	182	168	183	193	189	149	167	180	187	204
" 16	129	166	179	192	188	200	191	181	200	200	184	222	199
" Av.	122	136	135	145	153	163	158	163	161	163	163	172	176
" P. E.	*11*	*14*	*16*	*16*	*14*	*16*	*16*	*16*	*18*	*13*	*12*	*17*	*15*
" Av. Er.	0	0	1	0	1	0	1	0	0	0	0	0	0

* In designating the order, numbers are used in place of the actual geometrical forms pasted on the fronts of the small boxes. Thus, the order, 1, 2, 3, 4, 5, means that the small boxes were arranged from left to right as follows: star, circle, square, cross, triangle. The order was changed every second day.

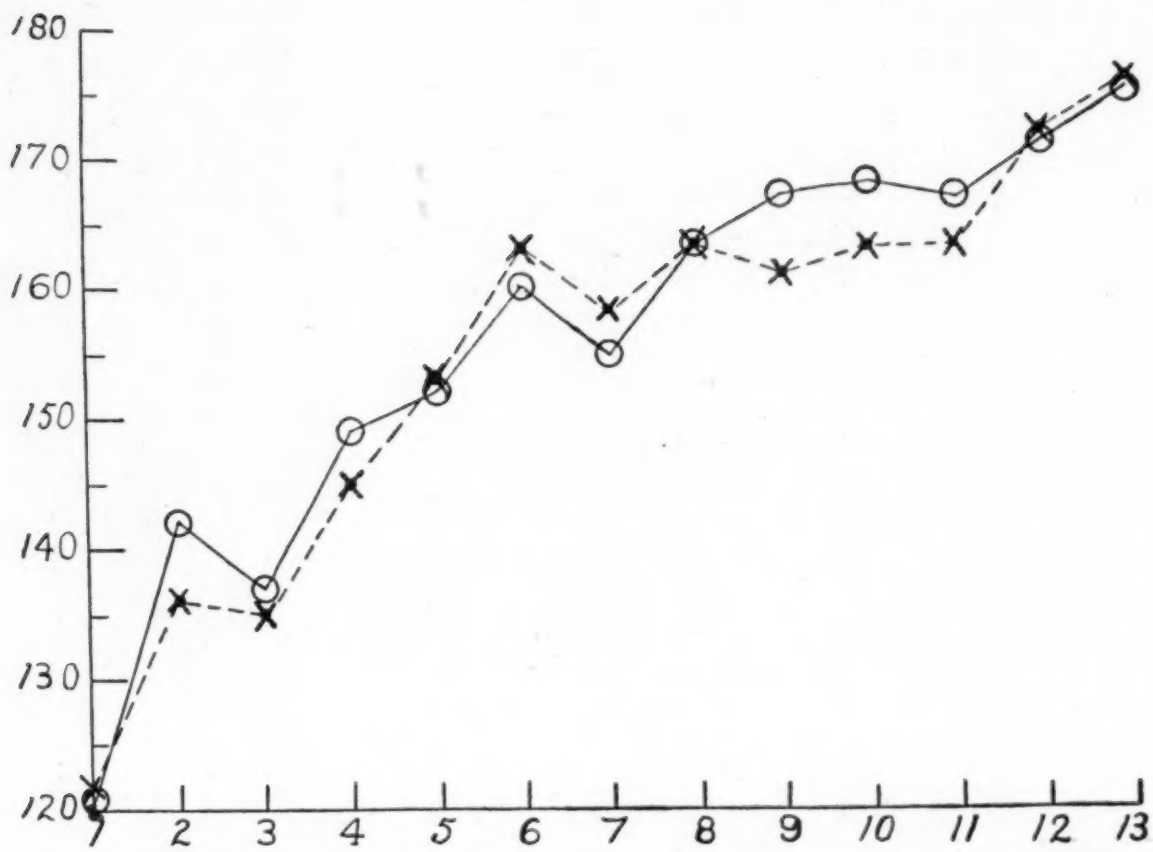

FIGURE 1.—Practice Curves. Ordinates represent the group averages, and abscissae, the number of days practice. The results obtained with the feeble-minded group are represented by circles, connected by continuous lines, and those with the normal group, by crosses, connected by dashes.

TABLE III

The Absolute and Percentage Improvement of Each Child of Both Normal and Feeble-Minded Groups

	Feeble-Minded				Normal			
Child	Initial	Final	I	% I	Initial	Final	I	% I
1	129	175	46	36	147	197	50	34
2	94	146	52	55	144	176	32	22
3	154	201	47	33	130	191	61	47
4	112	203	91	81	119	166	47	39
5	120	193	73	61	114	197	83	73
6	108	167	59	55	118	159	41	35
7	127	144	17	13	107	173	66	62
8	94	209	115	123	125	163	38	30
9	136	166	30	22	100	132	32	32
10	120	142	22	18	122	213	91	75
11	138	184	46	33	113	186	73	65
12	125	182	57	46	104	163	59	57
13	83	111	28	34	99	144	45	45
14	127	212	85	67	121	156	35	29
15	122	103	—19	—16	155	204	49	32
16	104	149	45	43	129	199	70	54
17	124	179	55	44				
18	140	214	74	53				
19	142	208	66	47				
20	114	203	89	78				
—	—	—	—	—	—	—	—	—
Av.	121	175	55	49	122	176	55	46

The question of main interest in connection with Tables II and III and Figure 1 is, whether the feeble-minded children show the same improvement with practice as do the normal children. This question, from whatever angle studied, must be answered in the affirmative. The equality of ability between the two groups (secured so far as initial ability is concerned by their manner of selection), remains fairly intact throughout the course of the practice, and is as definite at the end of the practice as at the beginning. For each group, the absolute improvement in average ability is 54, or about 45%. Upon computing the averages of the percentages of improvement shown by the individuals of each group (Table III), we obtain an average of 49 for the feeble-minded children and one of 46 for the normal children.

In both groups, the linear correlation between the initial abilities of the children and the percentages of improvement is negative, the correlation being —.36 (P. E., .13) for the feeble-minded group and —.40 (P. E., .14) for the normal group. If, instead of computing the correlation between initial ability and percentage of improvement, we compute that between initial ability and absolute improvement, we find in the case of both groups that the correlation remains negative but becomes very small (and unreliable), changing for the feeble-minded group from —.36 to —.13 (P. E., .15) and for the normal group from —.40 to —.11 (P. E., .17). On the average then, there was a tendency in both groups for the children who were below the average in initial ability to improve, relatively, more than, and absolutely, almost as much as, those who were above the average in initial ability.

So far we have spoken of amounts of improvement. It remains to be considered whether there is any difference in the regularity of the improvement of the individuals of the two groups,—whether the feeble-minded child shows greater fluctuation or irregularity in his practice curve than does the normal child. To determine this point, a table was constructed showing how much each child deviates each day from the general average of his group. The mean variations of these deviations were then calculated for each child. These mean variations serve as a fair measure of the regularity in the individual practice curves. The averages of the mean variations of the two groups may be used to compare the regularity in improvement of the normal children as compared with the feeble-minded. The average of the individual mean variations thus calculated was, for the normal group 9.0, P. E. $_{Av.}$, 0.3, for the feeble-minded group, 10.7, P. E. $_{Av.}$, 0.6. The difference is 1.7, P. E., .67. It is thus evident that the feeble-minded children showed somewhat greater irregularity in their improvement, but the difference being less than three times the probable error of the difference, is not great enough to have much significance.

To sum up, in the present experiment, feeble-minded children were found to show the same amount of improvement and to improve in accordance with essentially the same practice curve as normal children of the same mental age and the same initial ability. While in both the feeble-minded and normal groups

there existed great individual variation, it was impossible to discover any effects of practice which were significantly different for the two groups.

These results were obtained from one sort of work and on small groups of children. It is, therefore, interesting to inquire if there is any previous work that tends to indicate that the present results could not be generalized. So far as the writer can discover, there is not. Practice curves obtained on normal and feeble-minded children of the same mental age have not hitherto been published. Colvin has read a paper[4] on practice and transference in normal and subnormal children but has not as yet published his data. Without the complete data, on an experiment of this sort, one cannot judge of the validity of any conclusions that might be drawn. Kuhlmann and others have published studies of practice in feeble-minded children, but they have not used normal children for comparison.

Kuhlmann takes for granted[5] that the feeble-minded improve less with practice than normal children, but he does not say, expressly, less than normal children of the *same mental age*, or less than normal children of the same initial ability. Of course, we must remember that his study was made in 1904, before the origin of the Binet and Simon scale for measuring intelligence. The writer does not find anything in Kuhlmann's results that could not be duplicated in normal children. Slow progress or even retrogression is not necessarily a sign of an abnormal practice effect. The recent work of Ordahl and Ordahl,[6] undertaken at the suggestion of Kuhlmann, shows practice curves from feeble-minded children that are as *normal* as could well be imagined.

Now it is true that we can get at the characteristics of the feeble-minded by comparing them with normal persons of the same chronological age. We thus come to the conclusion that they are characterized by inability to learn, by lack of attention, by incapacity for sustained voluntary effort, by lack of judgment and reason; but all these shortcomings characterize a six-year-old child compared with a ten-year-old child. Before we can conclude that the feeble-minded differ in any of these characteristics

[4] *Proceedings of the American Psychological Association*, Psychol. Bull., 1915, Vol. XII, p. 67.

[5] *Experimental Studies in Mental Deficiency*. Amer. J. of Psychol., 1904, Vol. XV, p. 413.

[6] J. of Psycho-Asthenics, Monog. Sup., Vol. I, 2, p. 33 and elsewhere.

from normals of the same mental age, we must carefully compare them with normals of the same mental age.

Some prejudice against admitting that feeble-minded children improve with practice as much as normal children of the same mental age probably exists because of the tendency to identify capacity for mental development with ability to learn, with ability to gain by practice. The writer sees no reason for such an identification, but believes that the preceding data (which will be corroborated by results to be presented on the control groups) strongly suggest that it is not inability to learn which characterizes incapacity for mental development, but inability to grow, and that the two are quite distinguishable. The matter of the spread of training has, however, to be carefully considered. It may be that normal and feeble-minded children of equal mental age show the same improvement in the activity practiced, but unequal spreading of that improvement to related activities. The data obtained on this question will be presented in a subsequent paper.

AN INVESTIGATION INTO THE RATE OF MENTAL ASSOCIATION

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No apology is needed for a re-investigation of this problem. Association and associative memory form the basis of all intellectual life; the rate of association alone is of absolute importance to teachers in determining their rate of questioning; and definitely attested facts procured by experiment in association can never be too numerous.

The present investigation seeks mainly to determine the question of the rate of mental association. Ziehen in his pioneer work on *Association* suggested that the rate decreased with age. His subjects were so few in number that it is not surprising to find contradictory results shown in a later investigation by Rusk.[1] And although Meumann in the second edition of his *Vorlesungen* (Vol. I, p. 513) accepted Rusk's results, the latter was not satisfied that any scientific conclusion had been obtained, and after communication with Meumann, agreed that only a new investigation with a larger number of subjects of each age could give reliable averages and determine the question. The objections which Rusk foresaw, and of which he warned Meumann, have since been urged by Whipple.[2]

The present experiment has therefore been undertaken. Rusk's technique has been adopted, but on his recommendation certain improvements have been made, as follows:

(*a*) The number of subjects was increased; 15 8-year-olds, 26 10-year-olds, 22 12-year-olds, 18 14-year-olds, and 10 adults were taken. The majority were girls.

(*b*) The median of results (as before) was taken as the representative figure for each individual, but to secure greater reliability and to facilitate calculation the series was arranged to comprise 19 members. The 10th thus became the representative figure, and half the difference between the 5th and the 15th was regarded as the semi-interquartile variation.

(*c*) The series was limited for this experiment to uncontrolled concrete associations.

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[1] British Journal of Psychology, Vol. III, part 4, p. 349.
[2] *Manual of Mental and Physical Tests*, 2d ed., Part II, p. 78.

(*d*) Only one form of instruction was employed. The imagery was not to be investigated, so the instruction was simply: "Give the first word." "As quickly as possible" and "Take your own time" were both omitted.

The median is to be preferred as the representative figure because it is more reliable than the average which allows abnormal results to interfere unduly with the representative value.

The series used consisted of the following words—*Gun, Water, Lamp, Piano, Watch, Butter, Purse, Barrel, Stamp, Market, Picture, Ink, Motor, Ribbon, Coal, Rain, Post, Mat, Horse, Table, Foot, Hat, Boot.* Only 19 of these were registered for each child: the order of presentation was constantly varied.

Tabulation of Results

TABLE I

Summary of the Results for the Time of Response of Each Age-Group

Age	Number Subjects	Average of Individual Medians	Fastest Individual Median	Slowest Individual Median	Average Semi-Quartile Deviation
8	15	2.6	1.6	5.0	.8
10	26	2.3	1.4	5.0	.7
12	22	1.7	1.0	3.0	.4
14	18	1.57	1.0	3.0	.6
Adult	10	1.5	1.0	2.2	.3

(There were 3 boys in the Age 8 group and 5 men in the adult group. All figures are in seconds.)

TABLE II

The Median Time of Response of Each Age-Group to Each Stimulus Word

Age	Gun	Water	Lamp	Piano	Watch	Butter	Purse	Stamp	Market	Picture	Ink
8	2.3	2.8	2.4	2.6	2.7	2.6	2.5	2.8	3.6	2.6	2
10	2	2.35	2	2	2.1	2	1.7	1.8	3.4	2	2
12	1.6	1.95	1.2	1.4	1.4	1.4	1.6	1.4	1.6	1.9	1.2
14	1.7	2	1.2	1.6	1.4	1.4	1.2	1.4	3.4	1.8	1.2

Age	Motor	Ribbon	Coal	Rain	Post	Mat	Horse	Table	Foot	Hat	Boot
8	2.8	2.2	2.2	4	3.6	2.2	2.7	2.3	2.9	2.4	2
10	2	1.6	*2	*2.6	2	3	3.2	2.5	*2.3	2	2
12	1.4	1.5	*1.4	*1.7	1.45	2	1.4	1.4	*1.8	1.4	1.5
14	1.5	1.6	*1.9	*2.4	1.4	2	2	1.5	*2.1	1.3	1.3

(Out of these 22 words, different sets of 19 only were presented in varying order to each subject.)

Rate of Response

The average of the medians for each age is shown in the following figures.

Age 8	2.6 seconds
Age 10	2.3 "
Age 12	1.7 "
Age 14	1.57 "
Adults	1.5 "

This seems to point to a definite increase in speed of association from year to year up to the age of 14, and confirms Ziehen's suggestion.

It is notable that there is practically little difference between the results for Age 14 and for adults. The suggestion is made, however, that after 14 the rate of association may slow down again, on account of greater thought being given to the content of the word, and the existence of a wider range of associations from which to choose. It is possible, of course, that this tendency might not prevail against that of correlative and purely verbal association.

On the whole, as regards both rate and quality of association, the results obtained from adults by this method are likely to be less reliable than those obtained from children; the answers are less spontaneous, candid, and unreflecting.

Quality of Response

1. In analysing the results from the standpoint of intelligence, the experimenter was led to attach much more importance to the varying types of answer than to the mere speed of reaction.

The subjects were drawn from free primary schools and from the primary and secondary departments of a higher-class school. Each group was graded according to intelligence on an estimate based partly on class-places, and partly on the teacher's verdict. No definite correlation could be established between this grading and that based on speed of association, more especially in regard to pupils from the higher-class school. In free-school pupils there was no correlation at all between speed of reaction and originality of response, but there was a certain correspondence between speed and the class-place assigned by the teacher. This looks as if rapid attunement of answering, at the expense of

thought, leading to a rigid and mechanical handling of class subjects, were characteristic of the free primary school in this particular instance.

The ease and quickness with which the nature of the experiment was grasped afforded a much more satisfactory test of intelligence. Speed in comprehension of a new idea—which is not the same as simple association might conceivably be an index of intelligence.

2. Despite the immense variety of individual responses, it is possible to group the answers into three main classes: (*a*) associations on the same plane of thought, such as *rain—hail, watch—time, ribbon—hair;* (*b*) associations denoting use or activity, as *piano—playing, purse—opens, ink—write, ribbon—tie;* (*c*) associations describing some quality of the thing given, as *butter—salt, gun—shiny, ribbon—blue.*

These three types of association are referred to as Relatives, Activities, and Qualities, respectively. Word completions have been classed as Relatives.

In the light of Stern's categories of observation, it is interesting to consider the percentages of each type for different ages.

i. At Age 8 we have a balance between Relatives and Activities. Only a few showed preponderance of Qualities, which in every case were colors. The actual percentages are: R, 43.2; A, 42.5; Q, 14.3.

ii. At Age 10 a mixed type emerges, a combination of activity and relative association, such as *horse—drives a cart, ribbon—tie it on your hair, lamp—some people can't afford gas and have a lamp* (given in 1.4 sec.!). This type has been called AR. When it is grouped with pure Activities, the balance is still maintained between Activities and Relatives, while the number of Qualities remains approximately the same, viz: R, 43.7; A, 29.8; AR, 13.9; Q, 12.6.

iii. At Age 12, however, a great difference is shown. Activities are now relegated to a subordinate position, and the mixed type disappears entirely, while Relatives greatly preponderate. The percentages are: R, 80; A, 10.7; Q, 9.3.

iv. At Age 14, Activities are practically negligible. Relatives still preponderate, but Qualities emerge in a most significant manner. The percentages are: R, 56.9; Q, 38.3; A, 4.8.

Of course, these results are only generalizations. Some 10-year-olds, for example, display the characteristics attributed to

Age 14. But the gradual elimination of Activities is quite certain, and the undue presence of Activities in the answers given by an older child would be a fair indication of backwardness.

Answers given in proportion from all three classes might be expected from the cleverest children. With girls of 12, however, answers consisting entirely of Relatives were obtained from the brightest and cleverest in the class.

3. The problems suggested by perseveration were first outlined by Meumann. He distinguished three different kinds, which Rusk has formulated as P_1, P_2, and P_3. Roughly speaking, P_1 is the repetition of the same word in response to many different stimuli; P_2 is the recurrence of a certain form of expression; P_3 is the recurrence of a certain type of relation (adjectival, etc.) which determines the reproduction.

Meumann asserts that "the degree of perseveration varies inversely with age and intelligence." This sweeping indictment seems indiscreet. In distinguishing these three types of perseveration, some discrimination in the quality of the answers is necessary, especially in cases of P_3, (Cf. Winteler's classification of mental types). A subject who responds adjectivally to all concrete stimuli may yet give highly characteristic adjectives describing essential qualities, and cannot be classed on the same mental level as one who reacts indiscriminately to various objects with comparatively vague adjectives like *big* or *new*.

Many cases of P_3 have been observed by the experimenter where the varied range of adjectives given points to developed observation and a high degree of intelligence. Only where P_3 is accompanied by P_1 could it be taken as indicative of a low standard of intelligence.

P_1 occurs chiefly in younger pupils who show marked dullness in other respects—*e. g.*, children very slow at reading, and slow to grasp the nature of the response required. P_1 is practically restricted to children of 10 and under: there is a slight tendency towards it in a few girls of 14.

P_2 varies in quality with age. In children of 8 and 10 it is a certain symptom of undeveloped power of expression, coinciding with backwardness in reading; in older pupils and in adults it usually takes the form of word-completion and seems to be of very doubtful value as an index of intelligence. Of course,

where it marks an early approximation to the adult type, unseasonable precocity may be mistaken for cleverness, so that the class-place of the child would be no criterion.

Cases of perseveration were very rare among those children who belonged to the "relative" class and were most frequent in those who gave a preponderance of qualities. In connection with the rate of association it is worth noting that the dull types of perseveration (P_1 and P_2), which save thinking, are sometimes conducive to increased speed.

4. The special capacities of the pupil are shown to a certain extent by the type of imagery predominant in the responses. Visual imagery is the most common. In all the girls of 14 any predominance of color-qualities in the responses coincided with a special aptitude for drawing and painting, shown in the class records. Auditory imagery was practically non-existent in the responses given by children under 12; the girls of 12 and 14 who reacted noticeably with auditory imagery, such as *watch—tick*, *market—noise*, *motor—honk-honk*, *gun—bang*, were without exception good at music. The very few who paused to pick and choose their words in giving an association were found to excel in English. One girl, brilliant at mathematics, who found great difficulty in expressing her imagery, had the same difficulty in English composition.

5. The experimenter was interested most of all in cases of total or partial inhibition—where association of any kind was either wholly absent or present only after an inexplicable lapse of time. Total inhibition occurred only in nervous pupils, but was not caused by conscious shyness or fear. Fatigue or suppressed hysteria may account for it, but the writer's ignorance of the matter is so great that she shrinks from making suggestions. Unfamiliarity with the object presented could not have been the cause, as the most ordinary words such as *horse*, *mat*, *picture*, *watch*, were among those which called up no association whatever. It is also remarkable that inhibition was confined to clever children. The problem of inhibition in association calls for further investigation.

PROBLEMS OF TEACHER MEASUREMENT

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Teacher measurement, in the sense of estimating the efficiency of teachers individually, is not a new and theoretical proposal, but an existing supervisory responsibility. This statement needs no demonstration. But some discussion may be necessary of the further statement, that, in so far as teacher measurement is at all reliable and consistent it must be controlled by some sort of schedule or list of items representing qualities of teaching merit. Such a schedule may never have been set down on paper; indeed, its possessor may hardly be aware of its existence. But it is humanly impossible for a supervisor to report from year to year upon the efficiency of the various members of his teaching staff, accepting the responsibility for their retention, advancement, demotion, or dismissal, and particularly for their assistance and improvement while in service, without having formulated, clearly or crudely, somewhere in his mind, a statement of the factors which in his opinion constitute efficient teaching.

The current efforts of experimentallists in the field of teacher measurement are only attempts to extract from the consciousness of principals and supervisors these personal criteria of good teaching, and to assemble and condense them into a single objective schedule, thoroughly tested, by means of which every judge of teaching may make his estimates more accurate, and more consistent with those of other judges. There is nothing new about the entire movement except the attempt to objectify what already exists subjectively, and to unify and render universal what is now the scattered property of many men.

There are those who believe that the movement toward teacher measurement is a monstrous innovation, which threatens the holiest traditions of the educational profession by putting a premium upon mechanical methodology. It is not an innovation. But the phrase "teacher-measurement," itself, no doubt, is in part responsible for this misunderstanding, as it suggests a mathematical exactness of procedure which is clearly impossible in this field. Teacher measurement will probably never become more than a carefully controlled process of *estimating* a teacher's individual efficiency. The phrase is, however, sufficiently con-

venient and euphonious, and has now been used widely enough, to warrant its continuation.

To students who are familiar with the reports of current studies in this field there occur objections to present procedure of a more fundamental character. However sympathetic one may be with the general plan of devising schedules for teacher measurement, it is difficult to justify many of the methods by which these investigators have attacked the problem. For example, all of them appear to have set up as their goal the construction of a schedule which can be applied to any teacher, whether in the elementary or high school, and irrespective of the grade or subject in which his teaching is being done. "Teaching is teaching," is the evident assumption, "and the same wherever found." But it may reasonably be maintained that different qualities and methods, at least in part, are requisite for a teacher's success in the primary as contrasted with the grammar grades, and that the criteria of good teaching are not entirely the same in the different departments of the high school and of yet higher institutions. In so far as the criteria of good teaching *are* the same in these very diverse situations, it seems probable that the comparative importance to be attached to each must differ. If these contentions are correct, the problem is to devise, not a single blanket schedule for universal application, but a series of independent schedules for teachers of different grades and subjects in the elementary and high schools. If, on the other hand, these statements are not true, and if a single schedule can actually serve in place of many, the surest way to discover that fact is to begin by constructing schedules for specific grades and subjects. Only if the different specific schedules eventually prove to be alike, can a single blanket schedule wisely be substituted for them.

The second major criticism to be urged upon existing studies of this sort is that there is an unnecessary and wholly unjustifiable overlapping among the various items or rubrics comprising the proposed scales. Logically, there are three possible planes upon which an estimate of teaching efficiency may be constructed: (1) the plane of results or of pupil achievement; (2) the plane of the teaching and learning process; and (3) the plane of the teacher's equipment for teaching, both native and acquired. This kind of analysis appears not to have been made by the

investigators whose work has been reported. Certain items in their schedules have been drawn from the plane of results (for example, "the growth of pupils in subject-matter"),[1] others have been taken from the plane of the schoolroom process (such as "skill in stimulating thought"), and still others have come from the plane of the teacher's equipment ("academic" and "professional preparation"). Clearly, in so far as elements in the schoolroom process are real factors in teaching efficiency they are measured once in the measurement of results. To measure them again, independently, is to measure them twice. Similarly, academic and professional preparation, in so far as they have actually affected teaching, and hence have become real factors in efficiency, are measured once when results are measured, are measured again when the teaching process is measured, and are measured yet a third time when measured by themselves. In precisely the same way, results are measured indirectly in the measurement of the teaching process, and are again measured indirectly when one measures the teacher's equipment for his work. Assuming that the various items representing each plane of measurement have been selected at random, but that none of the planes is represented completely by the items chosen, we have no *a priori* means of determining which of the respective items have, in reality, been measured three times, which have been measured twice, and which have been measured only once.

Not only has there been an unrecognized overlapping of the levels of measurement from which the individual items of the schedules have been taken, but there has been equally unrecognized overlapping among the items representing each level. To take a single illustration: In Boyce's scale, among the items representing the plane which we have described as "the teacher's equipment," we find the rubrics "health" and "voice." Ordinary observation alone is sufficient to convince one that health is frequently a large factor in determining both the quality and the control of a teacher's voice. This one illustration could be multiplied many times. Indeed, there is hardly an item in this or in the other scales which does not clearly overlap upon one or more of the other items making up the schedule.

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[1] The examples given in parentheses are taken from the tentative schedule proposed by BOYCE, in Part II of the Fourteenth Year Book of the National Society for the Study of Education, page 45. Illustrations of the same sort of combination might be drawn from other published schedules.

It would, of course, be a hopeless task to attempt the construction of a schedule in which all of the items would be mutually exclusive. But it is highly desirable, in fact it is necessary, to reduce this overlapping to a minimum, and to utilize such methods as are available to estimate or to eliminate the effects of unavoidable duplication. Investigators in this field have not only permitted the grossest overlapping to occur among the component items of their scales, but they have failed to make use of available methods for eliminating its disturbing consequences.[2]

In the third place, students of teacher measurement appear to have erred in that they have attempted too much. The writer is strongly of the opinion that, for the present at least, efforts to construct a schedule for teacher measurement should be confined to a single one of the three planes which have been enumerated. Doubtless in the end we shall want to know as much as possible about all three; and to combine in our final estimate of a teacher's merit all attainable facts as to her equipment, her classroom procedure, and the results which she achieves. But at present we should do wisely to project our investigations upon one plane at a time, and to make each of these investigations as thorough as it is possible to make it. Later, when we know the nature and comparative value of the various items necessary to adequate judgment upon all planes, there will be time and opportunity for putting together the different schedules into one.

Let us endeavor to make this matter concrete. Let us suppose that each of the planes referred to contains ten elements of efficiency; in other words, that there are ten elements in the teacher's inherited and acquired equipment, ten elements in an effective teaching process, and ten requisite elements of results. Is it not clear that a schedule made up of ten elements comprising, for example, the plane of the teaching process, would be a more permanent achievement than a schedule made up of ten items distributed over all three planes? A schedule made up of items confined to one plane need not be disturbed by advances subsequently made upon the other planes, but a schedule whose

[2] Attention may here be called to the mathematical formula known as the "regression equation" which has been used by T. L. Kelley, C. T. Gray, and others, to eliminate the complications arising from the sort of difficulty that we have described.

items are distributed over all three planes must be completely revised with every discovery made upon any plane. The great advantage of confining endeavor to a single level at one time is that results secured upon that level can stand undisturbed by contemporary or future achievements made upon different levels. It is customary and wise to lay the foundation securely before rearing the house, and not to try to construct both the foundation and the superstructure at the same time.

While other cogent reasons might be advanced for urging the concentration of an investigator's energies along a single plane, the one that has been given is sufficient. Without further argument of the point, therefore, let us try to determine which of the three levels offers the best prospect of useful results.

The plane of results (in the sense of changes wrought in pupils) would be the ideal plane upon which to build an estimate of a teacher's individual efficiency, if it were possible (1) to measure all of the results of teaching, and (2) to pick out from the body of measured results any single teacher's contribution. At present these desiderata are impossible to attain. Only the more mechanical products of a teacher's efforts can now be subjected to accurate appraisal, and means exist for the measurement of only a small portion of these. This fact is no indictment of present efforts in the field of educational measurements. Let us continue to measure such results of teaching as we can, and let us by all means extend our facilities for this purpose; but let us not make the mistake of assuming that the results that we can measure are the only results of teaching, or even that they are the most important part.

Moreover, we must keep constantly in mind the fact that the results which pupils achieve in any given subject are by no means the product of the labor of any single teacher. Earlier teachers, other contemporary teachers, and the environment external to the school, are all factors in determining pupil efficiency in any school subject. It has been urged that the influence of these complicating factors can be materially reduced by measuring only the change in pupil achievement which takes place under the guidance of a single teacher. But it must be remembered that this process only reduces these complications; it does not and cannot eliminate them.

It seems clear, therefore, that we are not now in a position to base an estimate of a teacher's individual efficiency upon the measured power of accomplishment shown by her pupils, nor even upon the measured change in the power of accomplishment which takes place under her tuition. We have not the facilities for measuring all of the results of teaching, nor for determining for what part of the measurable results any single teacher is responsible. Under such circumstances, we must turn to the other levels which have been described in search of more encouraging possibilities.

Of the remaining levels, that of the teaching process seems to offer greater promise than that of the teacher's equipment for teaching. The test of a teacher's efficiency is not so much what she *can do* as what she *does*. That teacher is inefficient who is doing inferior work, no matter what the standard of work she may be able to maintain; and that teacher is efficient, though certainly not the most efficient, who is doing good work, irrespective of her ability to better it. But when a teacher's present efficiency has once been ascertained, facts relative to her latent abilities become of great significance, as the means for guiding her progress upward to higher planes of usefulness. The securing of these facts, however, constitutes a separate problem.

Our discussion has now brought us to the level that we have called the plane of the "classroom process." It is upon this plane that the writer recommends immediate and concentrated investigation, This level is superior to the level of results in that it is here possible to differentiate more clearly the activities of a single teacher, and it is superior to the plane of equipment in that it represents actual and not potential efficiency. It is also, in all probability, more readily measurable than the other planes. However, measurement upon this level is not without its serious difficulties.

One of these difficulties is that of defining accurately the meaning of the classroom process. Does it include teacher-activities, or pupil-activities, or both? There is good reason for urging that it be confined to pupil-activities. Pupil-activities alone are responsible for the growth of pupils, and it is for stimulating the growth of pupils that schools and teachers exist. On the other hand, pupil-activities are to no small degree a joint product, due to influences flowing from all the teachers in the school, and

from agencies outside the school. No one teacher can be given the entire blame or credit for the doings of the pupils in her classroom. Only the teacher's own activities represent herself.

The common-sense answer to our question seems to be that the "classroom process" should be regarded as including the activities of both teachers and pupils. This is the meaning adopted by the practical supervisor, who, when visiting a classroom for the purpose of judging the quality of instruction, looks at both teacher and pupils for indications of what is going on. Why should the schedule-maker do less than this? It is the purpose of a schedule, not to rob a supervisor of any of his sources of information, but to guide him in the use of these sources to the end that he may draw from each one all that it has to give.

If the reader accepts the propositions that have been advanced thus far, he should be ready to accept the suggestions which follow for the guidance of future research in the field of teacher measurement. Let the investigator select a single school grade or subject, and confine himself for the time to the elaboration of a schedule for teacher measurement in that alone. Let him also limit his efforts to a single plane of measurement, for the time at least; preferably to the plane of the classroom process. Let him not attempt the visionary task of developing a schedule for measuring all teachers, in all grades and subjects, and upon all planes.

There is one apparent objection to these proposals that should be mentioned. It would be impossible, under this policy, to reduce one's estimate of a teacher's efficiency to a single statement, such as a mathematical per cent. The ratings given a teacher in native ability and preparation, in classroom efficiency, and in results as manifested by the achievements of her pupils in standard tests, would have to be kept strictly independent of each other for a long time to come. Not knowing their relative importance, it would be impossible to transmute these different statements of efficiency into one. But the writer is unable to see that this fact forms a valid criticism. Hasty reduction of these various statements to one is to secure a final statement that is false. Furthermore, what is the practical utility of a single mark for representing a teacher's efficiency? Would any sane supervisor recommend the discontinuation of teacher's services simply because she fell below a stipulated percentage mark in

terms of any schedule? Would any responsible board accept such a recommendation if it were made?

A supervisor's judgment of the final merit of each of his teachers must be formed in the future as it has been formed in the past. Assembling in his mind all of the obtainable facts with regard to a teacher's work, he must form his opinion as to her needs and her deserts in the light of these facts plus his knowledge of the needs of his particular school. The promotion, discharge, or constructive criticism of teachers cannot be reduced to mathematical formulae. The proper function of a scorecard for teacher measurement is not to substitute such a formula for a supervisor's personal judgment, but to aid him in discovering and assembling all the data upon which intelligent judgment should be based.

ABSTRACTS AND REVIEWS

LEWIS M. TERMAN. *The Measurement of Intelligence. An Explanation of and a Complete Guide for the Use of the Stanford Revision and Extension of the Binet-Simon Intelligence Scale.* With an editorial introduction by Ellwood P. Cubberley. Riverside Textbooks in Education. Boston: Houghton Mifflin Company, 1916. Pp. xviii + 362.

In this book Professor Terman has rendered a profound service to society as well as to education and science. The author modestly omits an account of the magnitude of the work which he undertook with but a few associates, and presents only the end products of his labors. The subject of intelligence has never received its due as a basis of educational and sociological theory, but in this book one finds almost the first textbook on the subject. Throughout the presentation the author shows a splendidly sympathetic appreciation and evaluation of the contributions of Binet and Simon and makes repeated acknowledgement to their pioneer researches.

The first three chapters present a general introduction to the purposes and values of intelligence tests and the nature of the Binet-Simon method, with a clear statement of the essential relation of intelligence to pedagogy. Chapters four to seven describe the nature of the Stanford revision and extension of the Binet-Simon Scale, including a detailed discussion of the reliability of the method and the significance of results obtained by its use. This includes a complete statement of the author's attitude toward the "intelligence quotient" (I. Q., the ratio of mental age to life age) as a means of expressing intelligence status.

Part II consists entirely of a complete guide for the use of the Stanford Revision, which is as detailed and as nearly "fool-proof" as such directions could be made. Miscellaneous statistics of standardization are scattered throughout these thirteen chapters. There is an appendix of 89 selected bibliographical references on the use of intelligence tests, classified by subjects, some suggested books for a teacher's private library, and a brief list of American journals of clinical psychology.

The author agrees with Goddard that "not far from two per cent. of the children enrolled" in the public schools "must be looked upon as real defectives," and adds that "the number of children with very superior (intellectual) ability is approximately as great as the num-

ber of the feeble-minded," upon whom "the future welfare of the country hinges in no small degree." The results of investigations in the field of juvenile delinquency and cacogenic families indicate "that the most important trait of at least 25 per cent. of our criminals is mental weakness." The use of intelligence tests is urged as a necessary basis for school grading and for estimating vocational fitness. The intelligence of retarded children is found to be usually overestimated and that of superior children usually underestimated in teachers' judgments. "The retardation problem is exactly the reverse of what we have thought it to be. It is the bright children who are retarded, and the dull children who are accelerated." In these several conditions of social and educational adjustment is found the need for the measurement of intelligence, which must be undertaken by means of *standardized* mental tests.

Terman's description of the nature of the Binet-Simon method of measuring intelligence reveals intimate first-hand acquaintance with the publications of these authors, and contrasts pleasantly with the gross misrepresentations frequently encountered. One finds here an authoritative digest of the Binet-Simon publications which bear on the Measuring Scale. It was the purpose of the Stanford revision to eliminate the statistical inaccuracies of the American standardizations of this Scale, to standardize procedures, to eliminate undesirable tests and substitute others, and to extend the Scale to the valid measurement of adolescent and adult levels of intelligence. The revision and extension are based on the results of individual examinations of approximately 2300 subjects, although only about half of these were used in the final tabulations. Forty tests in addition to those used by Binet and Simon were employed experimentally. It was intended to extend the number of tests to six at each year, but as finally arranged the upper years are presented in two-year intervals, with from six to eight tests per interval. Responses were recorded verbatim so as to permit of revised rescoring. All examiners were carefully trained for technique, and all responses were scored by Terman himself. Apparently these precautions increase the objective validity of the tests and eliminate personal equation of procedure and scoring. The subjects of school age were selected on the basis of average social status, and included all children in these schools who were within two months of a birthday, exclusive of foreign-born children. It may be noted in passing that this method of selection should operate in the direction of producing more consistent results, and should tend to reduce "scattering" to a minimum.

"The guiding principle was to secure an arrangement of the tests and a standard of scoring which would cause the median mental age of the unselected children of each age group to coincide with the median chronological age." The author "had already become convinced that no satisfactory revision was possible on any theoretical consideration as to the percentage of passes" commonly employed in mental test standardization. No doubt the current standardization criteria are far from meeting the demands of scientific exactness, and are in real need of revision, but the alternative method adopted by Terman seems hardly a satisfactory substitute. It leads to conclusions which are in reality only direct corollaries of this hypothesis. Moreover, the tests at each year must be so manipulated as to produce the desired result, and theoretically, at least, if only the end product is considered in this manipulation, many disadvantages might result. Furthermore, since the tests are arranged in a continuous year scale, a succession of years and the intercorrelation of tests must be taken account of. As a matter of fact, however, it appears that much use was made of the percentage criterion, and aside from theoretical objections the results indicate a real increase in reliability of the Binet-Simon method. It is unfortunate that the experimental data on which the revision is based (which is announced for early publication) could not have preceded the publication of the textbook on the use of the revision. For the present, one must accept the revision on faith, and must also reserve judgment on those experimental studies in which the revision is used as a basis. Until the experimental data are available for critical evaluation there is no means of comparing the Stanford revision with other versions of the Binet-Simon Scale, or of comparing results from the use of these scales. Undoubtedly, however, the practical aspects of the matter permit of no room for quibble.

The reliability of each test as a real measure of intelligence was determined by checking the results of each test against the revised scale as a whole. This was accomplished by grouping all subjects into I. Q. groups of below 90, 90 to 109, and above 110. "If a test fails to show a decidedly higher proportion of passes in the superior I. Q. group than in the inferior I. Q. group, it cannot be considered a satisfactory test of intelligence." Inasmuch as the scale as a whole has a demonstrated degree of reliability, this method affords a satisfactory empirical measure of the intelligence value of each test, assuming, it should be held, that the test is located with reasonable

accuracy, for a test may be a good measure of intelligence at one year and not at another.

One thousand intelligence quotients are analyzed and lead to several important conclusions. While agreeing in expectation with some of these conclusions, the reviewer feels that the demonstration is not convincing. To him it appears that the three important conclusions regarding the symmetrical distribution of intelligence (p. 67) result from the standardization hypothesis, at least in part, but in the absence of the complete experimental data (quite properly omitted in the present work, this contention can not be substantiated. There might also result some unexpected error from the selection of the subjects on the basis of average social status. The fact that the socially inferior are numerically greater than the socially superior, and that there is a correlation between intelligence and social class might skew the curves in the direction of inferior intelligence.

It is stated as an inference supported by re-tests of the same children at intervals of two to four years (data not cited) that "a child's I. Q., as measured by this (Stanford) scale, remains practically constant." It is also contended that the I. Q. automatically transforms the "age-grade method" to a "point-scale method." We should expect the advocates of the point scale method to object to this contention. The inference with regard to the constancy of I. Q.'s seems rather hastily made. If correct it would prove an invaluable diagnostic aid. But for the feeble-minded at least, it is improbable that individual I. Q.'s do remain constant. The potentially feeble-minded, for example, contradict this influence—indeed, the type was first defined as those mental defectives who are "at age" intellectually. Neither can the I. Q. be used without specific precautions as a means of classifying mental defectives, unless the I. Q. ratio is *not reduced* to a decimal expression. This point is illustrated by the author's cases. M. S. and R. M. (p. 82) both have I. Q. = .60, but the former has a mental level of 4.5 and is technically an imbecile, while the latter has a mental level of 9.0 and is technically a moron. If the I. Q.'s of these two children were to remain constant to 16 years, the former would ultimately possess a mental age of 9.6 as would also the latter. This expectation is not in accord with experience with feeble-minded children. Nor would it be fair at the present time to consider the two children as similar (which the reduced I. Q. does) when in fact the mental age of the one is exactly twice that of the other. It is the mental age and not the decimal I. Q. which affords a basis for

educational expectation in feeble-minded children. The argument might be amplified by other examples drawn from pages 82 to 86.

Feeble-mindedness is defined by the author as an I. Q. value "rarely above 75." "All who test below 70 I. Q. by the Stanford revision of the Binet-Simon scale should be considered feeble-minded." But the incautious reader must not infer that this I. Q. limit constitutes the sole criterion of feeble-mindedness, except as the intelligence criterion supplements the social criterion, and, as is implicit in the author's statements in other publications, except as the intelligence is the most significant item in the diagnosis of mental defect. Similarly, "borderline," "dull normal," "average," "superior," and "genius" intellectual states are defined in terms of I. Q., supplemented by brief discussion and by case instances. But the reader must consider these I. Q. limits as intelligence classifications and not as mental diagnoses, as might be inferred. I. Q. is found to correlate with social status, with quality of school work, and with grade progress, with the implication that these are expressions of intelligence levels and not causes thereof.

A chapter on "reliability of the method" criticizes the accuracy of the revision from the standpoints of examiners' training, subjects' attitudes, influence of coaching, repetition of tests, and social and educational advantages. This experimental analysis clearly contradicts any serious invalidating effect of these factors so often ascribed to them.

It is beyond the scope of this review to consider Part II in detail. This section is a compendium of instructions, both general and specific, which is as nearly ideal as language and experimental foresight could contrive. The author's extensive experience with the tests and with students thereof has enabled him to anticipate the majority of exceptional difficulties with which the novice is confronted. The standards of procedure and of scoring are for the most part unequivocal and objective, and are at least in some degree experimentally determined. It is unfortunate that the results of the historical study of the Binet-Simon Scale could not be presented. The reviewer understands that a complete tabulation was made preceding the experimental investigations on standardization of the Scale, including procedures used, scores, and results. This colossal work is barely referred to in the present text, although its presentation would be invaluable to research students.

Let us hope that those who in the future employ the Stanford revision will do the new scale the justice of spending at least a fraction of their time in digesting the contents of this book, which leaves them but little excuse for error. Let us hope, too, that with such a careful foundation laid, we may hope to spend less time in future discussing the materials of intelligence testing and give more to its application. From the latter there will necessarily result much that is essential to the former.

E. A. Doll.

Vineland, N. J.

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EDITORIAL

INITIATIVE, ORIGINALITY AND ROUTINE EFFICIENCY

Educational theory needs light from psychology upon several problems. One of the most important of these has to do with what we have been calling "initiative." This important mental trait, or complex of traits, is not only frequently referred to in our educational discussions, but seems to hold the central position in all current constructive doctrines. Traditional precepts of school management, particularly those that emphasize obedience and routine, are criticized on the ground that they tend to crush initiative; the systematic mastery of subject-matter has been condemned on the same basis; and the most significant opposition to a type of vocational education that emphasizes the mastery of skills involves the assumption that skill and initiative are antithetical terms. An outstanding feature of the Gary movement and of Mr. Flexner's proposed "modern school" is the assumed inconsistency of habit and initiative and the consequent neglect of the former and emphasis of the latter.

Theoretical arguments can be advanced both for and against these current assumptions, but it is very difficult to cite scientifically established facts on either side. Is the quality that we call initiative a native mental endowment or is it a product of inspiration and training or is it the resultant of a favorable environment working upon a favorable innate diathesis? If it is thoroughly innate, is it a primary unit character or a mosaic of hereditary factors? If it is either wholly or partially an acquired characteristic, what are the conditions favorable to its development? Is thoroughness of mental mastery inimical to the development of this important trait or is thoroughness an indispensable factor in its growth?

BROADER ASPECTS OF THE PROBLEM

Thorndike, in the *Teachers College Record*, cites his recent studies of engineering abilities as evidence that a high measure of initiative may co-exist with a high measure of routine efficiency. If it can be shown that there is a causal connection between the two factors a start will be made toward the solution of a most important problem, and in any case the suggestion that the two may co-exist in the same individual should be a healthful corrective to the rather dogmatic antagonism toward drill routine, and habituation represented by the Gary and Flexner movements. Certainly no predication of current educational doctrine is so heavily fraught with significance to educational statesmanship as is this assumed antithesis between skill, routine, and thoroughness on the one hand, and constructive ability on the other hand. As an example of its far-reaching potentialities, one may cite the position taken by an ethnologist, Mr. Madison Grant, in a recently published book, *The Passing of the Great Race* (Scribners, 1916). Mr. Grant apparently assumes that both initiative and capacity for routine mastery and efficiency are distinctive and specialized racial traits, neither of which is likely to coexist with the other. His book is fundamentally an argument for the recognition of a privileged class which shall devote itself to administrative and constructive efforts, leaving the routine work to be done by those less favorably endowed. A doctrine which is apparently so thoroughly out of harmony with the ideals of American democracy should certainly challenge investigation.

W. C. B.

NOTES AND NEWS

Announcement is made of the founding of a new *General Science Quarterly*, a periodical devoted to the interests of science teaching in the elementary and secondary schools, to be edited by W. G. Whitman, of the Salem State Normal School.

The faculty of Vassar College has decided that students shall be informed of their marks after examinations, and has adopted the scale of marks A, B, C, D, E, F, with D as passing. The mark A will signify marked ability, and in elementary classes will be given to not more than five per cent. of the students. The mark B will signify "good," and will be given to from twenty to thirty per cent. of the students, C will mean "average," and will include forty to fifty per cent., while E demands re-examination, and F the repetition of the course.

A medical clinic for examining delinquent, nervous, subnormal, and abnormal children has been opened in the university hospital, University of Minnesota. The departments of education, psychology and sociology of the college of science, literature and the arts are assisting in making examinations of these children. The work is directly under the medical school.—*School and Society.*

The California state board of health has prepared a bill providing for the establishment of a state psychopathic hospital in San Francisco near the University of California Medical School. The hospital will provide a research laboratory and treatment for patients requiring special or intensive study for a short period.—*Science.*

At the Royal Institution, London, Professor C. S. Sherrington is giving a course of six lectures on "The Old Brain and the New Brain, and Their Meaning."—*Science.*

On Monday evening, February 26, the New York Branch of the American Psychological Association met at Columbia University. The following papers were read: "The Effect of Method of Presentation on Immediate Memory for French Vocabulary" by C. E. Farnum; "Correlation of Interest and Ability" by J. D. Jackson; "Psychological Analogy in Political Theory" by J. P. Turner; "The In-

fluence of Mental Set upon Association" by M. A. May; "Maze Experiments with White Rats" by G. J. and H. A. Ruger.

A bulletin dealing with the use of standard measurements of reading, handwriting and arithmetic in the public schools is to be issued by the Bureau of Educational Measurements and Standards of the Kansas State Normal School at Emporia.

A special four weeks' course in the scientific determination of musical talent is announced by Professor C. E. Seashore at the University of Iowa from July 30 to August 24. The course will consist of a daily lecture on the psychology of musical ability, and two hours a day devoted to experimental and practical work in the measurement of musical talent.

Edward Thompson Fairchild, president of New Hampshire College, died on January 23. President Fairchild was state superintendent of public instruction in Kansas for five years before going to New Hampshire, and was President of the National Education Association in 1912–13.

On January 26 Superintendent Ben Blewett, of St. Louis, died suddenly of heart failure while he was addressing a committee of the Congress of Constructive Patriotism. Superintendent Blewett was connected with the St. Louis schools for many years, serving as assistant superintendent and as superintendent since 1897. He was a man of kindly, lovable disposition, and one of the broadest minded school superintendents in the country.

Dr. William Healy, for eight years director of the Juvenile Psychopathic Institute in Chicago, has accepted an appointment as psychopathologist on the Judge Harvey Baker Foundation in connection with the Boston Juvenile Court.

Wilford M. Aiken has been appointed assistant professor of the principles of education, and E. Leigh Mudge instructor in psychology, in Ohio State University.

Miss Bessie Lee Gambrill has been appointed head of the department of psychology at the Trenton, New Jersey, State Normal School.—*Atlantic Educational Journal.*

PUBLICATIONS RECEIVED

LEONARD P. AYRES. *The Cleveland School Survey (Summary Volume).* Cleveland: The Survey Committee of the Cleveland Foundation, 1917. Pp. 363. Fifty cents.

In this volume the director of the survey sums up the history of the investigation, the methods pursued, and the results that have been presented in greater detail in the other twenty-four volumes of the series. Among the more interesting chapters for the psychologist are IV, New Contributions to Education, resulting directly from the survey; VI, The Teaching Staff; VII, What the Schools Teach and Might Teach; VIII, Measuring the Work of the Public Schools; IX, Health Work in the Public Schools; X, Schools and Classes for Exceptional Children; XII, Education through Recreation; XV, The Public Library and the Public Schools; and XIX, School Organization and Administration. It is noteworthy that while much is said about exceptional children this always means defective children, and that there is not a word about the education of exceptionally bright children—the class whose education is by far the most profitable investment for society.

BIRD T. BALDWIN, and others. *A Survey of Psychological Investigations with Reference to Differentiations between Psychological Experiments and Mental Tests.* Report of the Committee of the American Psychological Association on the Academic Status of Psychology, 1916. Pp. 34.

This pamphlet presents the results of a questionnaire investigation in which the views of 115 members of the American Psychological Association were secured on the relation between psychological experiments and mental tests. The author summarizes the findings as follows: "In general, psychological experiments and investigations aim to promote psychology as a science, formulate general facts and principles, discover new truths, analyze facts of consciousness and behavior in order to secure types or averages and obtain data for an analytic, systematic science. Mental tests represent the applied side or the technology of psychology, emphasize individual differences and attempt to diagnose or measure what is known and to determine the qualitative growth of mental traits from year to year for individuals and groups. They are based on empirical standardizations; they are not as a rule elaborated in process of application; they supplement and throw light on the theoretical problems underlying the science and if viewed critically they become material for psychological investigations."

GEORGINE BURCHILL, WILLIAM L. ETTINGER, AND EDGAR DUBS SHIMER. *The Progressive Road to Reading.* Boston and New York: Silver Burdett and Company, 1916. Book I, pp. 128, 32 cents. Book II, pp. 160, 40 cents. Introductory Book III, pp. 176, 40 cents. Book III, pp. 192, 45 cents. Introductory Book IV, pp. 240, 48 cents. Book IV, pp. 288, 50 cents. Book V, pp. 320, 55 cents. Plan of Work, pp. x, 98, 25 cents.

"The Progressive Road to Reading method is based on the fundamental principle that reading consists in getting thought from written or printed symbols. From the very beginning the sentence is the unit of thought, and the relation among words is never lost sight of." Stress is laid on the content of the reading matter, and on the psychological response awakened in the mind of the child. Throughout the entire series the selections are characterized by their marked literary element and by the appeal which they make to the child's imagination.

MABEL COOK COLE. *Philippine Folk Tales.* Chicago: A. C. McClurg and Company, 1916. Pp. xv, 218.

These tales were collected by the author in the course of a four years' residence in the Islands, and are the first publication of Philippine folk lore in popular form. Here we have tales of the creation, of the deluge, of transformations into animals, of spirits, gods, heroes, men, beasts, and devils. It is a most admirable collection, and footnotes show the connection between the incidents of the tales and the folk lore of other countries.

GEORGE V. N. DEARBORN. *College Entrance Mathematics.* Reprinted from School and Society, 4: 1916, p. 634.

The author attacks the present requirement of algebra for college entrance as useless, time killing, and destructive of interest. Geometry, he believes, has some value, but, following algebra as it does, it is "made to seem more or less horrid by association." There may be disagreement about the relative value of algebra and geometry, but it seems quite obvious that college entrance mathematics is destined to receive a thorough overhauling in the near future.

E. A. DOLL. *Anthropometry as an Aid to Mental Diagnosis. A Simple Method for the Examination of Sub-Normals.* Publications of the Training School at Vineland, New Jersey, Research Department, No. 8, February, 1916. Pp. 91.

This monograph is intended as an aid to the diagnosis of the feeble-minded, rather than as a contribution to anthropometry proper. The data include the results of 477 sets of measurements, embracing height (sitting and standing), weight, right and left hand grip, and vital capacity. The results are presented by mental age groups,

with the chronological age indicated in each case. In all the measurements the feeble-minded are distinctly below the normal. This is most strikingly the case in vital capacity, and least so in weight. Many of the groups of girls are above the normal in weight. There is a close correlation between the psycho-physical average and mental age. An appendix of 12 pages gives Smedley's percentile tables for school boys and girls in the traits here considered. The monograph is a valuable addition to our knowledge of the feeble-minded, and will be widely used for reference.

J. Gordon Dorrance. *The Story of the Forest.* Cincinnati: The American Book Company, 1916. Pp. 237.

This little book tells how trees live and die, how to know the trees, how the logs are brought to the mill, and how paper, charcoal, tanbark, turpentine, and maple sugar are gotten from trees.

A. A. Douglass and W. L. Dealey. *Micromotion Studies Applied to Education.* Reprinted from the Pedagogical Seminary, 23: 1916, 241–261.

The authors contend that the use of moving picture films to record the finer adjustments in behavior will be a valuable supplement to present scales in education.

Charles Redway Dryer. *Elementary Economic Geography.* Cincinnati: The American Book Company, 1916. Pp. 415.

The first part of this book treats of human economies and their natural foundations, as plant, mineral, and marine resources, industry, and trade. Part two discusses the resources of the chief geographical divisions of this country.

Arthur William Dunn. *The Social Studies in Secondary Education.* Bulletin, 1916, No. 28. Washington: Bureau of Education, 1916. Pp. 63. Ten cents.

This is the report of the committee on social studies of the commission on the reorganization of secondary education of the National Education Association. It provides a six-year program adapted to both the 6–3–3 and the 8–4 plans of organization. The report is a noteworthy contribution to the aims and methods of teaching history.

Frederic Ernest Farrington. *Public Facilities for Educating the Alien.* Bulletin, 1916, No. 18. Washington: Bureau of Education, 1916. Pp. 51.

The bulletin gives a brief account of evening schools, supervision, teaching staff, publicity methods, and other aspects of the effort that is being made to assimilate our illiterate immigrant population.

ALFRED LAWRENCE HALL-QUEST. *Supervised Study. A Discussion of the Study Lesson in the High School.* New York: The Macmillan Company, 1916. Pp. xvii, 433. $1.25.

The author states that the aims of the present book are as follows: "(1) To formulate a tentative conception of supervised study; (2) to indicate what should be included in a course on teaching the high school pupil how to study; (3) to describe in detail the various schemes of organization by which the supervision of study is administered in a large number of schools; (4) to apply the principles and methods of supervised study to some of the subjects in the high school program; (5) to summarize the results of the more significant investigations aiming to prove the effectiveness of supervised study; (6) to collect the data on supervised study that have appeare in several periodicals within the last five years and that may not have been accessible to the majority of teachers." These aims seem to have been realized with a considerable degree of success, and the book will repay careful study by the high school teacher.

DWIGHT LOWELL HOOPINGARNER, TRUMAN LEE KELLEY AND LEROY WALTER SACKETT. *Laboratory Experiments in Educational Practice.* Austin, Texas: Published by the Authors, 1916. Pp. 95.

This laboratory manual in educational psychology is an advance edition for use in the authors' classes, and represents an attempt to furnish elementary students with an introduction to experimental procedures in education. A glance at the table of contents (control of association, memory, imagination, the perceptual process, the higher thought processes, the control of attention, motor learning, suggestion, individual differences and mental measurements) shows that the book rests on the traditional classifications of psychology, and a closer inspection of the exercises leads one to question the immediacy of their connection with educational practice. There are experiments with paired associates, free association, opposites, part and whole learning, effect of pauses in memorizing, simple versus intricate material in memorizing, recall of definitions, vividness of imagery, effects of multiple presentation in spelling, contrast illusions, effect of mental attitude upon perception, word completion test, practice without knowledge of results, concept formation, factors in the control of attention, mirror tracing, and correlations of mental traits. In order to prevent anticipation of the experiments by the students, the leaves of the manual are fastened together like a pad, and are not to be opened until the instructor so directs. The book is an interesting attempt at the selection of class experiments that will be of value for students of education, but could be improved by drawing the materials more largely from schoolroom work.

ARTHUR W. KALLOM. *Standards in Silent Reading, with Suggestions on how Teachers may Test Their Pupils in Silent Reading.* Bulletin No. XII of the Department of Educational Investigation and Measurement. Boston: Printing Department, 1916. Pp. 24. Seven cents.

The first part of this report gives an account of the efforts made by the Boston school authorities to improve the work in oral and silent reading, presents the results of the application of the Kelly reading tests to 118 pupils in grades IV to VIII, and describes the W. S. Gray oral and silent reading tests. The second part contains a series of selections chosen by a committee of teachers to serve as standards for the grades mentioned. The pupils are to be tested both by reproduction and by questions. Directions are given for scoring the results and for measuring the improvement of individuals and classes, but there are no records of the application of the tests.

THOMAS HUNT MORGAN. *A Critique of the Theory of Evolution.* Princeton: Princeton University Press, 1916. Pp. x, 197. $1.50.

This is a valuable survey of the past theories and present knowledge of evolution by one who has made noteworthy contributions to that subject in recent years. Chapter I outlines the four great historical speculations ascribing evolution to (1) the environment, (2) use and disuse, (3) the unfolding principle, and (4) natural selection, and sketches the evidence for evolution adduced from comparative anatomy, embryology and paleontology. Chapter II discusses the bearing of Mendel's discoveries on the origin of heredity, and illustrates the points with instances drawn from recent experimental findings. Chapter III deals with the factorial theory of heredity, the behavior of the chromosomes, and the composition of the germplasm. According to the author's calculations the germ-plasm of Drosophila, the fruit fly, contains something like 7500 different kinds of factors. Chapter IV considers the Darwinian theory of natural selection in the light of these studies, and concludes that "natural selection, as here defined, means both the increase in the number of individuals that results after a beneficial mutation has occurred (owing to the ability of living matter to propagate) and also the preponderance of certain kinds of individuals in a population that makes some further results more probable than others." The causes of mutations are still as far from our grasp as ever.

Report of an Inquiry into the Administration and Support of the Colorado School System, made under the Direction of the United States Commissioner of Education. Bulletin, 1917, No. 5. Washington: Bureau of Education, 1917. Pp. 93. Ten cents.

This report discloses many unsatisfactory conditions in Colorado schools. The rural schools are poorly constructed, badly equipped,

and unsanitary, the teachers are selected for anything but their professional qualifications, the course of study is ill-adapted to the needs of the pupils, and there is practically no supervision. Little seems to have been done in the way of school consolidation. Important recommendations are made for systematic administration and supervision of the schools, and for their more adequate financial support.

DAVID SNEDDEN. *Problems of Secondary Education.* Boston: Houghton Mifflin Company, 1917. Pp. xiv, 333. $1.50.

In view of the avowedly unsatisfactory condition in which many high school subjects are found at present this vigorous and direct treatment of high school problems will challenge attention. For the sake of informality and a somewhat more personal expression of his views the author has thrown what he has to say into the form of letters to various school officials. There are twenty-five of these, directed to all sorts of people from the president of the university to the teacher of physical training. Both the high school and the college are educational agencies for the benefit of the people, and neither should dominate the other, but both should study their problems from a scientific point of view in order that they may coöperate to secure adequate continuity and thoroughness in study and the greatest flexibility in meeting the needs of the individual student. Throughout the book emphasis is laid on the necessity of scientific study of high school problems, whether the person addressed be the college professor of education training teachers for high school work, the principal of a regular or industrial high school, the entire high school teaching body, or the teacher of Latin, English, history, mathematics, physics, biology, music, home economics, or manual training. Many of the concrete problems are set forth in clear and definite fashion, and the author's opinion is given for what it is worth.

ISIDORE SPRINGER. *Teachers' Year Book of Educational Investigations.* New York: Department of Education, Division of Reference and Research, 1916. Pp. 53.

The present year book, which is the third issued by this division, contains in part I a summary of recent publications on educational scales and measurements, and in part II a discussion of topics in teaching efficiency and school organization. The investigations summarized include Buckingham's list of problems in arithmetic; Witham's, C. T. Gray's, and Starch's studies in handwriting; Ayres' and Starch's spelling scales; Childs' application of the Thorndike drawing scale; the Starch grammar scales; and the Kelly and Starch reading tests. The section on teaching efficiency reports Shiels' investigation of teachers' ratings, Boyce's efficiency record, and the score-card for classroom observation devised by the Bureau of Municipal Research. Brief mention is made of Greany's and Springer's studies on the results of vocational guidance of grammar school pupils, Springer's study of retardation and ideational type, and other studies of teachers' marks, size of class, and supervised study.

WINIFRED SACKVILLE STONER. *Manual of Natural Education.* Indianapolis: The Bobbs-Merrill Company, 1916. Pp. 216.

The author's ten commandments for natural education are: Never give corporal punishment, never scold, never say "Don't," never say "Must," never allow a child to say "I can't," never refuse to answer a child's questions, never frighten a child, never ridicule or tease a child, never allow a child to lose self-respect or respect for his parents, never banish fairies from home. Other important principles for which the author contends are training for parenthood, teaching children how to play, encouraging children to teach what they have been taught, teaching all languages by the natural method before the twelfth year, teaching facts by means of jingles, early use of the typewriter in teaching the mechanics of language, mental work for early years and mental rest for the adolescent period. The book contains many more interesting and novel suggestions for primary education, and will repay careful study by any mother or teacher.

GEORGE D. STRAYER. *Some Problems in City School Administration.* Yonkers-on-Hudson: The World Book Company, 1916. Pp. xi, 225. $1.50.

This is the latest number of the School Efficiency Series, and presents the results of the Butte school survey. The book is divided into two parts, of which Part I deals with such administrative problems as organization of the school board, relation of the board to the superintendent, selection and training of teachers, the salary schedules, school buildings and equipment, school census and attendance, and school records. Part II is of greater interest to the psychologist, dealing as it does with the instructional problem. There are studies of the amount and causes of overage, special classes, failures by subjects, estimates of the quality of instruction, a detailed examination of the courses of study, tests of the achievements of pupils, the supervision of instruction, and the adaptation of the schools to the needs of the community. In pupil measurements the Ayres spelling lists were used, and the results by grades ranged from five to fifteen per cent. above the average for twenty-two cities. The compositions, rated by the Hillegas scale, showed a tremendous amount of overlapping from grade to grade, and were very much lower than those of corresponding grades in New York and Maryland. Penmanship, rated by the Thorndike scale, showed an even greater amount of overlapping, and the Courtis arithmetic tests, Series B, gave a similar picture, but showed an efficiency superior to that found in other cities in all operations except addition.

E. L. THORNDIKE, W. A. MCCALL AND J. C. CHAPMAN. *Ventilation in Relation to Mental Work.* Teachers College Contributions to Education, No. 78. New York: Teachers College, 1916. Pp. 83. $1.00.

This is a report of a series of experiments carried out under the auspices of the New York State Commission on Ventilation, and

deals with the effects of the conditions of the air upon mental work, upon the rate of improvement of mental functions, upon the accuracy of judgment, and upon the choice of alternatives to mental work. The results from the experiments were consistently negative. "When an individual is urged to do his best he does as much and does it as well, and improves as rapidly, in a hot, humid, stale and stagnant air condition as in an optimum condition. This result was obtained when the individuals were subjected to the bad air conditions four hours a day for five consecutive days. Enough individuals were tested to make the result entirely reliable." It would seem from this study that the current teachings of textbooks and medical journals on the depressing effects of bad air for mental work need to be scanned with a skeptical eye, as resting on sentiment rather than fact.

C. W. VALENTINE. *An Introduction to Experimental Psychology in Relation to Education.* Second Impression. Baltimore: Warwick and York, Inc., 1916. Pp. x, 194. $1.10.

The fact that in less than a year after its issue a second impression of this little book has been called for is a good index of the favor with which it has been received. The reasons for this popularity are doubtless the simplicity and practical nature of the experiments, and the compactness and directness of the discussions. Of especial interest are the experiments on learning vocabularies, on the value of a map, on the accurate evaluation of errors in mirror tracing, on motor memory, on mental multiplication, and on the apprehension of numbers.

J. E. WALLACE WALLIN. *Psycho-Motor Norms for Practical Diagnosis.* Psychological Monographs, Vol. 22, No. 2. Whole No. 94. 1916. Pp. v, 102. $1.00.

The sub-title of this monograph, "A Study of the Seguin Form-Board, Based on the Records of 4072 Normal and Abnormal Boys and Girls, with Yearly and Half-Yearly Norms," is more descriptive of its scope. The various chapters deal with the increase of psycho-motor capacity with chronological and mental age, its relation to grade of intelligence, sex differences, the influence of familiarity and repetition, and the amount of variability. While there is some discrepancy between the findings of different investigators, there is a general agreement that formboard performance improves steadily with chronological age in normal children, and with mental age in feeble-minded children. Boys are superior to girls, and this superiority seems more marked with increasing intelligence. There is a constant and marked improvement with repetition, and this is greater with sub-normal than with normal, with duller than with brighter children. The more intelligent are able to make a speedier initial adjustment, and thus their earlier records are relatively nearer their maximum. The variability is greater for sub-normal than for normal children, and decreases with practice in both groups.